Vol. XXII No. 1

DISSERTATION ABSTRACTS

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ANN ARBOR, MICHIGAN: 1961

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TABLE OF CONTENTS

The Table of Contents lists in alphabetical order the principal subject headings of the dissertations abstracted. For the convenience of readers an alphabetical author index is included following the abstracts.

AGRICULTURE 1
- Animal Culture 7
- Forestry and Wildlife 10
- Plant Culture 13
- Plant Pathology 20

ANATOMY 24

ANTHROPOLOGY 25

ASTRONOMY 26

BACTERIOLOGY 26

BIOGRAPHY 32

BIOLOGY - GENETICS 33

BOTANY 40

CHEMISTRY 44
- Analytical 44
- Biological 47
- Inorganic 58
- Organic 63
- Pharmaceutical 84
- Physical 86

ECONOMICS 106
- Agricultural 109
- Commerce-Business 115
- Finance 120
- Theory 120

EDUCATION 121
- Administration 130
- Adult 143
- History 143
- Physical 145
- Psychology 147
- Religion 169
- Teacher Training 169
- Theory and Practice 176

ENGINEERING 186
- Aeronautical 187
- Agricultural 188
- Chemical 190
- Civil 205
- Electrical 208
- Mechanical 213
- Mechanics 216
- Metallurgy 217
- Mining 217
- Nuclear 218
- Sanitary and Municipal 219

FINE ARTS 219

FOOD TECHNOLOGY 221

GEOGRAPHY 223

GEOLOGY 227

HEALTH SCIENCES 232
- Hygiene 232
- Pathology 233
- Public Health 233

HISTORY 234
- Ancient 235
- Modern 236

HOME ECONOMICS 242

LANGUAGE AND LITERATURE 245
- Classical 251
- Linguistics 252
- Modern 254

MATHEMATICS 267

MINERALOGY 277

MUSIC 279

PHARMACOLOGY 283

PHILOSOPHY 285

PHYSICS 287
- Electronics and Electricity 289
- Nuclear 290
- Solid State 296

PHYSIOLOGY 301

POLITICAL SCIENCE 307
- International Law and Relations 313
- Public Administration 315

PSYCHOLOGY 317
- Clinical 319
- Experimental 329

RELIGION 338

SOCIAL PSYCHOLOGY 345

SOCIOLOGY 349
- Family 354
- Race-Question 356

SPEECH-THEATER 357

ZOOLOGY 364

MONOGRAPH 371

INDEXES (Subject and Author) . . . . . following page 373

AGRICULTURE, GENERAL

CORRELATIONS BETWEEN CERTAIN CRITERIA OF RUMINANT DIGESTION IN VIVO AND IN VITRO

(Order No. Mic 61-2419)

David Merle Bowden, Ph.D.
Oregon State College, 1961

Major Professor: David C. Church

The objective of the study reported herein was to determine the usefulness of a simplified in vitro procedure in assessing the nutritive value of feedstuffs to the ruminant animal. This procedure involved the digestion of samples of a feedstuff by diluted rumen liquor in glass centrifuge bottles. Digestion was carried out for 48 hours in a constant-temperature water-bath at 39°C.

A simplified determination of dry matter digestibility was of particular interest. Dry matter digestibility was determined from the residue remaining in the fermentation bottles after incubation with rumen liquor. Residue which could be collected in a sintered glass disc crucible was considered to be indigestible. In some trials the amounts of volatile fatty acids produced during the digestion process were determined by a column chromatographic technique.

Substrates used in the study were mainly forages but a few mixed feedstuffs were included. The largest amount of information was gathered on 39 samples of tall fescue (Festuca arundinacea). Samples represented two to four cuttings per year of four genotypes over a four year period. Cuttings were made as the forage reached pasture height. A sample of alfalfa hay was included in each trial to give a measure of the variability in the digesting capacity of the rumen liquor inocula used in different trials.

Within-trial coefficients of variation of dry matter digestibility for all substrates digested were generally small and were comparable to those reported for other in vitro digestion procedures. Cellulose digestibility showed a slightly higher within-trial variability.

Analysis of variance revealed significant differences in the digestibility of the standard alfalfa in different in vitro trials.

The correlation between in vitro dry matter digestibility and in vivo dry matter digestibility was highly significant. Correlations on a within-year basis indicated lower correlations for the tall fescue sample which had been held in storage.

Correlations using the pooled information from all fescue samples revealed a high positive relationship between the in vitro digestibility of dry matter and cellulose with measures of in vivo digestibility. The simplified procedure of determining in vitro dry matter digestibility is as accurate as in vitro cellulose digestibility for estimating the in vivo digestibility of forages.

Crude protein content of the forages was positively correlated with both in vitro and in vivo measures of forage digestibility.

Intraclass correlations revealed that in vitro digestibility measures were ineffective in predicting in vivo digestibility when genotypes within a cutting were considered. Crude protein content of the forages also showed a very low correlation when considered on a within-cutting basis.

Comparison of fresh frozen and oven-dried tall fescue samples as substrates for in vitro trials showed a greater between-trial variability in cellulose and dry matter digestibility with the frozen forage. Oven-dried samples gave as good agreement with in vivo digestibility as did the frozen samples.

Molar percentages of acetic, propionic, butyric and valeric acids produced were comparable with those reported in other studies on in vitro digestion of forages. Influence of the inoculum used on the molar percentages of acids produced from the standard alfalfa was noted.

Frozen and oven-dried forage as substrates gave essentially the same molar percentage and total amounts of volatile fatty acids, indicating that drying had little, if any, effect on the end-products produced from digestion of the forages.

Correlations of in vitro dry matter and cellulose digestibilities with total production of volatile fatty acids were consistent and high for all trials.

Microfilm $2.75; Xerox $4.80. 95 pages.

THE NITROGEN FRACTIONATION OF A CLAY TREATED SANDY SOIL

(Order No. Mic 61-1946)

Juan Colom, Ph.D.
Michigan State University, 1959

Major Professor: A. R. Wolcott

The distribution of nitrogen in a sandy soil which had received applications of clay three years previously was studied.

The addition of Wyoming Bentonite to the sand increased the electrophoretic mobility of its colloidal fraction. The C:N ratio was found to decrease with increasing application levels of clay, and this was due primarily to increases in total nitrogen. There was no relation between clay treatment and the hydrolyzable ammonia fraction, where inorganic nitrogen would appear. However, the close inverse relationship between cataphoretic mobility and carbon content suggested that organic, rather than inorganic, nitrogen compounds were principally effective in altering the charge on the clay.

The increase in nitrogen was due to increases in nitrogenous materials which were hydrolyzed in 6N-HCl and were soluble in the presence of excess $Ca(OH)_2$.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

Fractionation of the hydrolyzable nitrogen into basic and non-basic constituents with phosphotungstic acid showed that both constituents increased with clay treatments. However, no relationship between Van Slyke amino nitrogen and clay treatment was found.

The acid hydrolyzable materials were then fractionated into functional constituents by the process of column separation recommended for protein hydrolysates by Fromageot and Lederer. Basic materials such as diamino acids were retained on a silica column, the acidic or dicarboxylic on an alumina column, the aromatic on a charcoal column, and the final perfusate contained neutral non-aromatic materials. The recovery of basic and non-basic forms of nitrogen by this method agreed very closely with the phosphotungstic acid procedure.

A considerable proportion of the hydrolyzable nitrogen in these soils was found in the form of neutral non-aromatic constituents. They showed a marked tendency to increase with clay treatments. Aromatic forms of nitrogen were essentially unrelated to clay treatments, while the basic nitrogen constituents increased and the acidic decreased with increasing clay content.

Attempts were made to characterize amino acids in the soil separates by paper partition chromatography. Good separation of standard amino acids was achieved. However, no comparable separation was obtained with any fraction or separate from any of the soils. The ninhydrin-reactive compounds in these fractions were not present as free amino acids. Rather, the amino acids were complexed with other organic compounds which appeared to be aromatic in nature. It was not clear whether these complexes had been formed in the soil or whether they had arisen as artifacts during chemical treatment in the laboratory. However, their mobilities in phenol and in butanol-acetic acid on paper chromatograms were clearly influenced by the level of clay application.

The possibility that clay could have been present in the soil preparations was rejected on evidence from X-ray analyses. Glycerated soil hydrolysates proved to be X-ray amorphous. X-ray patterns of unglycerated preparations showed no diffraction angles within the limits of the native soil clay or of Wyoming Bentonite.

Microfilm $2.75; Xerox $7.00. 147 pages.

NITROGEN LOSSES IN GASEOUS FORM FROM DIFFERENT SOILS AS AFFECTED BY MANAGEMENT

(Order No. Mic 61-1529)

Hans Juergen Fack, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor L. E. Engelbert

Gaseous losses of nitrogen are well known to occur from water-logged soils. However, there is indication that gaseous nitrogen may also be lost from apparently well aerated soils. The increasing use of nitrogen fertilizers makes a better understanding of the fate of the applied nitrogen urgent.

Nitrogen changes in soils were studied in the greenhouse, field, and in a closed system. The first greenhouse study was conducted with Spencer silt loam, which was limed and received 300 ppm N in different mineral and organic form. The soil was kept fallow at optimum moisture in the greenhouse for 15 months. In order to detect nitrogen volatilization losses, the levels of total soil nitrogen were followed during this time. Results indicate that the soil had lost very little, if any, nitrogen during incubation regardless of treatment. Nitrate analyses showed rapid nitrification and consequent accumulation of nitrates in the soil.

In the second greenhouse study, several different soils received nitrogen applications in different mineral and organic form and were kept fallow at optimum moisture in the greenhouse for 28 months. Nitrogen volatilization losses were determined indirectly by following the levels of total soil nitrogen. Very little, if any, nitrogen was lost from Fayette silt loam, Parr silt loam and Plainfield sand. However, there was strong evidence of nitrogen losses from Kewaunee silty clay loam.

Field studies of denitrification are impeded by the difficulty of separating nitrogen volatilization losses from changes due to nitrate movement in the soil. In order to overcome the difficulties encountered in field studies of denitrification, chlorides were used as tracer ions. By considering the nitrate-chloride ratio rather than the actual amounts of nitrates in the soil, it was thought possible to differentiate between dilution and reduction of nitrates. Field studies were made on the plow layer of two different soils and the subsoil of one of them. Results indicate that very little, if any, gaseous nitrogen had been lost from the soils studied. The moisture content of both soils was below field capacity.

The effect of soil moisture contents in excess of field capacity on nitrogen loss in gaseous form was studied using closed systems and N^{15}. In contrast to the former methods, this gave a direct method for measuring soil nitrogen changes. Soil moisture levels in the field were followed in the spring of 1960. During the early spring they were consistently in excess of the field moisture percentage. These moisture levels were reproduced in soils incubated in closed systems. Results obtained with the plow layer of Waupun silt loam at 33% moisture content indicated that no gaseous nitrogen was lost over an 8 day period. In contrast, a significant nitrogen loss occurred when the same soil was wet up to 53% moisture. Of the 100 ppm of nitrogen added, 20 ppm were volatilized in 8 days. Closed system studies were also conducted with Kewaunee silty clay loam to confirm the apparent losses noted in the greenhouse. The soil was kept at 30% moisture during incubation. Seventy percent of the applied nitrogen volatilized in 8 days. It is believed that poorer aeration resulting from the fine texture and relatively poor structure caused this high loss. Waupun silt loam subsoil was incubated at moisture contents slightly higher than found in the field. In no case was a gaseous nitrogen loss observed. Small volatilization losses from the subsoil were noted when sucrose was added and the soil saturated.

In all cases of nitrogen loss, molecular nitrogen and nitrous oxide were noted as volatilization products.

Microfilm $2.75; Xerox $5.20. 104 pages.

NITROGEN-POTASSIUM RATIOS, CLIPPING HEIGHT AND CLIPPING FREQUENCY AS VARIABLES INFLUENCING YIELD, PERSISTENCE AND CHEMICAL COMPOSITION OF ORCHARDGRASS.

(Order No. Mic 61-2476)

William Kirk Griffith, Ph.D.
Purdue University, 1961

Major Professor: Dr. M. R. Teel

Orchardgrass fertilized factorially with three levels each of nitrogen (NH_4NO_3) and potassium (KCl) was harvested every 4, 5-1/2 and 7 weeks in 1958. A differential cutting height of 2 and 4 inches was introduced into each management at the time of the second harvest.

Nitrogen increased yields 3719 and 5481 pounds per acre over the control for the 150 and 300 pounds per acre rates respectively. Nitrogen fertilization increased the uptake of potassium and the nitrogen content of the grass. However, it decreased the food reserves.

Potassium fertilization increased yields in 1958 over the check plots 621 and 941 pounds per acre for the 200 and 400 pound rates respectively. Potassium decreased the fructose percent significantly during May and June.

Low clipping (2 inch stubble) caused severe stand reductions at high fertility. The greatest loss was noted with high nitrogen and low potassium. This was associated with the visual observation that nitrogen produced elongated sheaths. The 2-inch cutting thus caused severe leaf blade removal.

Asparagine accumulated in orchardgrass when the potassium content of the grass fell below 1.5%. This accumulation was evident only on the high nitrogen plots during July and August. In September the potassium increased coincident with a depression in the asparagine content.

Microfilm $2.75; Xerox $6.20. 127 pages.

THE INFLUENCE OF DIFFERENT CROPPING SCHEMES ON THE AMINO ACID CONTENT, TOTAL NITROGEN, AND TOTAL ORGANIC CARBON CONTENT OF SOIL.

(Order No. Mic 61-2477)

Umesh Chandra Gupta, Ph.D.
Purdue University, 1961

Major Professor: H. W. Reuszer

Total nitrogen and carbon, pH values, alpha-amino nitrogen, and content of individual amino acids were determined on Chalmers silty clay loam plots cropped for periods varying from 1 to 7 years to alfalfa, bromegrass, and corn. The plots were initially limed to an approximate pH value of 6.5 and adequately fertilized with phosphorus and potassium. During the course of the experiment all plots were fertilized annually with phosphorus and potassium fertilizers. Corn and bromegrass received a yearly application of 200 pounds of nitrogenous fertilizers.

Total carbon was determined by the Van Slyke-Folch procedure, alpha-amino nitrogen by the Van Slyke method, and individual amino acids by gradient elution from an exchange resin column.

After seven years of continuous cropping to alfalfa, bromegrass, and corn, soils had a nitrogen content of 0.31, 0.29, and 0.27% respectively. The higher nitrogen content in continuous alfalfa plots as compared to continuous corn plots was statistically significant.

Seven years of continuous cropping to alfalfa and bromegrass showed a carbon content (3.1 and 3.0% respectively) significantly higher than in soil cropped to either crop for only 1 year (2.46%). Seven years of continuous cropping to corn showed a carbon content of 2.52%, which was significantly lower than in the continuous alfalfa or bromegrass plots.

The carbon/nitrogen ratio of the plots cropped to bromegrass, and alfalfa, and corn was 10.55, 10.17, and 9.35 respectively. The higher C/N ratio in continuous corn plots was found to be statistically significant.

The pH values after 7 years of continuous cropping to bromegrass, corn, and alfalfa were found to be 6.25, 6.38, and 6.54 respectively. The lower values in bromegrass and corn plots were probably due to the acidifying effect of the nitrogenous fertilizers.

The content of alpha-amino nitrogen was found to range between 28.6 and 38.2% of the total nitrogen. A maximum of 38.3% of the total nitrogen was found in alpha-amino form in 7 years of continuous alfalfa plots. This was significantly higher than that of continuous bromegrass and continuous corn plots, which had 34.4 and 31.2% respectively. Corn following alfalfa or bromegrass caused a significant decrease in the percent of the total nitrogen present in the alpha-amino form.

Twenty-one ninhydrin reacting compounds were identified as follows: cysteic acid, glucosamine, chondrosamine aspartic acid, serine, threonine, glutamic acid, glycine, alanine, β-alanine, γ-aminobutyric acid, valine, proline, leucine, isoleucine, α-ϵ-diaminopimelic acid, ornithine, tyrosine, histidine, arginine, and phenylalanine. Three compounds reacting with ninhydrin could not be positively identified.

Soils cropped to 7 years of alfalfa, bromegrass, and corn had 903 mg, 605 mg, and 539 mg of amino acids, respectively. These differences were statistically highly significant. Amino acid values in soil cropped to 4 years of bromegrass were as high as in soils cropped to 7 years of bromegrass.

Of the amino acids identified glucosamine, chondrosamine, aspartic acid, serine, threonine, glutamic acid, glycine, L-alanine, glycine, β-alanine, valine, proline and isoleucine were present in predominant quantities. Analysis from 7 years of continuous alfalfa plots indicated that aspartic acid, β-alanine, and proline made up about 59% of the total amino acids, while in other treatments they made up small proportions.

Only 1 sulfur containing amino acid, cysteic acid was found to be present in all of the samples. The basic amino acids, ornithine, histidine, and arginine constituted 1.9 to 3.1% of the total amino acids. The content of α-ϵ-diaminopimelic acid varied from 0.9 to a maximum of 3.3% of the total amino acids.

Microfilm $2.75; Xerox $5.60. 112 pages.

ENVIRONMENTAL FACTORS INFLUENCING NODE BENDING OF SOFT RED WINTER WHEAT

(Order No. Mic 61-2485)

Malcolm Julius Johnson, Ph.D.
Purdue University, 1961

Major Professor: B. O. Blair

Node bending is a type of lodging in wheat which was observed at the Purdue University Agronomy Farm during the years 1953, 1957 and 1958. The top node of susceptible varieties becomes rubbery when subjected to wet weather at maturity and bends from the mechanical action of the wind.

This thesis is a report of research conducted to delineate the phenological and histological manifestations of node bending.

Three groups of material were studied in this research. One group consisted of eight soft red winter wheat varieties grown in 1958 and 1959 which represented a broad range of straw strength. Two of the varieties, Knox and Monon had known tendencies for node bending.

The second group comprised three varieties grown at two nitrogen levels with nitrogen application made at dates during 1958 and 1959.

A limited amount of material was available of four varieties grown with variables of day length and temperature in the controlled climate chambers.

Representative samples of all varieties and treatments were fixed in a 70% Formalin-Acet-Alcohol solution. Silicates were removed with hydroflouric acid and the material embedded for microtoming.

Transections 16 mμ in thickness were permanently mounted on microscope slides from several locations of the nodal region. The slides were stained with Safranin 0 and Fast Green.

Lignin determinations were made by rating the lignin from 1-6 by visually comparing slides with two sets of standards.

Cellulose estimates were made by measuring the birefringence exhibited by the cellulose under polarized light with a 200 M Photovolt exposure meter. Direct galvanometric readings were used rather than converting the data to foot candles.

Measurements were made on the sheath base length and diameter of the top node of the eight wheat varieties in 1958 and 1959. At a location which exhibited a differential to nitrogen application, two hundred culms of each of five treatments were measured at the final sampling for the following characters: number of nodes, internode length and diameter for each internode, sheath base length and diameter for each of the nodes, and total plant height. Statistical analysis and conclusions were made only from culms with five (the most frequent number) nodes.

The results of the phenological measurements indicated that in plots where node bending occurred the sheath base was significantly longer.

Measurements from the top node of the several varieties indicated a varietal difference in the propensity to elongation and that environment markedly affected elongation. Cool, wet conditions during the last stages of vegetative growth were favorable for elongation.

The lignin and cellulose estimates indicated that some varieties have characteristically higher cellulose or lignin contents than others. A variety may be relatively high in cellulose and relatively low in lignin or visa versa.

Some varieties are much more receptive than others to changing environment with respect to cellulose and lignin content, however cellulose and lignin react similarly to environment.

Nitrogen fertilization may increase or decrease the cellulose and lignin content of the node depending on how that fertilizer influences the physiological development of the plant.

A soft red winter wheat is capable of node bending when it is characteristically low in lignin and cellulose content and when it has a propensity toward sheath base elongation. A variety of these qualities will lodge when it is subjected to cool wet weather during the close of the vegetative period and wet weather with strong winds at maturity.

A cellulose-lignin product rating was developed which showed a close association to field straw strength ratings for the varieties tested.

Microfilm $2.75; Xerox $6.40. 131 pages.

EFFECTS OF RAINFALL ENERGY ON SOME PHYSICAL PROPERTIES OF SOILS

(Order No. Mic 61-2510)

Kamil Mehmet Sor, Ph.D.
Purdue University, 1961

Major Professor: Dr. A. R. Bertrand

It has been observed by many soil scientists and engineers that raindrops, upon falling on a cultivated soil surface, affect the physical properties such as water permeability, structure, and texture of the soil. These effects are generally attributed to the breaking down of the aggregates, particle rearrangement, packing, and puddling of the soil in the top layer. To study the physical changes occurring on and in the soils due to rainfall energy, a laboratory study was conducted using different rainfall intensities.

Various rainfall energies were provided by a rainfall simulator, in which the head of water was regulated by a pressure-head regulator. Soil was packed in a cylindrical infiltrometer to which were connected eight piezometers separating the soil column into seven layers. After air permeability measurements, the soil was saturated with deionized water from the bottom. Following the complete saturation, water permeability measurements were conducted before and after the application of rainfall. The soil column was then dried and layers of soil were taken out and labeled. On each soil layer mechanical analysis, specific surface, aggregate stability and organic matter analyses were performed.

To determine the duration of rainfall that was required to produce maximum change of water permeabilities of saturated soils, a periodic rainfall study was conducted. It was found that 30 minutes of rainfall duration at a rainfall intensity of 2.8 iph was enough to create maximum change in the physical properties of the soil under consideration. Therefore, all water permeability studies were carried out at 30 minutes rainfall duration.

After a 1.6 iph rainfall the water permeability, aggregate

stability, specific surface, clay and organic matter contents of the top layer (0-1.5 cm) of soils decreased considerably, while the sub-layers did not change. After rainfall of 2.8 and 4.0 iph the magnitude of the changes in these physical properties of the first layer was greater than those of 1.6 iph. In the second layer (1.5-3.0 cm) at 2.8 and 4.0 iph intensities some changes in physical properties were also observed although to a lesser extent. In general, the effects of 2.8 and 4.0 iph rainfall were about equal in magnitude, while the effects for the 1.6 iph rainfall were lower.

It was observed that the rate of water flow in a saturated soil profile is not entirely governed by the permeability of the least permeable layer.

Clays, labeled with Rb-86, migrated in the soil profile during the application of rainfall. About 1% of the clay migrated to a depth of 3 cm and about 0.1% reached a depth of 5.0 cm. Microfilm $2.75; Xerox $6.40. 135 pages.

THE UPTAKE OF POTASSIUM AND RUBIDIUM-86 FROM THE SOIL BY CORN ROOTS

(Order No. Mic 61-2515)

John Martin Walker, Ph.D.
Purdue University, 1961

Major Professor: Dr. Stanley A. Barber

The primary objective of this investigation was to determine how corn roots remove K from the soil. To investigate this, an experiment was conducted in which the volume of rooting media for corn, the exchangeable K level, and the percent of K saturation on the soil exchange complex were combined in a factorial arrangement of treatments. In a supplementary experiment, the amount of exchangeable K and the percent of K saturation were the same in each pot, but there were five distances between exchange sites. From these two experiments it was observed that uptake by 17-day old corn was dependent upon the level of exchangeable K in the soil. Uptake of K by 10-day old corn was dependent as well on the amount of active K present on the complex and the distance between exchange sites. The greater the root density of 10- to 28-day old corn plants in the soil, the greater the amount of exchangeable K per pot absorbed.

The exchangeable K levels determined after cropping in the first experiment, were average values based on a composite sample from the entire pot. A third experiment was designed to determine how uniformly the corn roots were removing K from different areas in a pot of soil. Rb-86 was used as a tracer for K to label different soil areas. Exchangeable K in each area was also determined after 10, 17, and 19 days. More uptake of K and Rb-86 occurred from the tops of the pots than from the centers and bottoms even after 17 days growth. Rb-86 and K uptake were highly correlated, and therefore Rb-86 appeared to be a suitable tracer for K in the one soil at the one level of exchangeable K used in this experiment.

A new technique was developed which made it possible to show actual patterns of Rb-86 uptake developed by corn roots growing in uniformly labeled soil. These patterns were obtained by taking autoradiographs daily over a three-week period of the labeled soil in which the corn was growing. By making densitometer tracings and visual observation of the autoradiographs, it was concluded that absorption of readily available Rb-86 occurred initially through the root tip. Since a relatively small amount of the exchangeable Rb was absorbed, uptake of Rb by 10-day old corn was then dependent upon the amount of active Rb present on the exchange complex. Subsequently, absorption occurred all along the root surface, depleting the soil almost entirely of Rb-86 in the immediate vicinity of the root. Considerable diffusion of Rb-86 into this area replenished the absorbed Rb, hence lowering the over-all Rb-86 level in the soil. This explained why uptake of Rb by 17-day old corn became dependent upon the total level of exchangeable soil Rb.

Since Rb-86 appeared to be a suitable tracer for K under these conditions, the preceding discussion on Rb-86 could be applied to K uptake.

In experiments in which the K and Rb levels of the soil were varied, greater amounts of Rb-86 were absorbed at low than at high levels of exchangeable K in the soil, while essentially the same amounts of Rb-86 were absorbed at high and low levels of Rb. Rb-86, therefore, did not appear to be a suitable tracer for K when comparing uptake at two exchangeable K levels in one soil.

It was found that far less Sr-89 was absorbed by corn roots than Rb-86. This would be expected, since there is a far greater amount of Ca and Sr than K and Rb available for absorption in the soil.

The new autoradiographic technique developed during the course of this investigation, can be used to study such influences on ion uptake as that of plant species, ion diffusion, moisture and temperature stresses, and different physical, chemical, and biological properties of the soil.

Microfilm $2.75; Xerox $5.20. 101 pages.

A STUDY OF THE MINERALIZABLE NITROGEN FRACTION OF SELECTED NORTH CAROLINA SOILS AND ITS RELATION TO CROP RESPONSES TO APPLIED FERTILIZER NITROGEN

(Order No. Mic 61-2297)

Charles Darrel Welch, Ph.D.
North Carolina State College, 1960

Supervisor: William Victor Bartholomew

An investigation was made of the relationships between nitrogen soil test values, delivery of plant-available nitrogen by soils and crop responses from nitrogen fertilization of Coastal Plain soils of North Carolina. In addition, evaluations were made of the probable utility of nitrogen soil test information in enhancing the precision of nitrogen fertilizer recommendations made in connection with a general soil testing program.

Total nitrogen and soil organic matter had similar relationships to nitrogen availability in soils. Protein analyses gave information similar to that obtained by total nitrogen and organic matter tests for the Norfolk soils, but results for the Portsmouth soils were somewhat erratic.

The use of dry matter production, by a test crop grown

in greenhouse pots was shown to be as good as nitrogen uptake for use in the evaluation of nitrogen soil tests. Nitrate production was significantly correlated with dry matter production for well-drained Coastal Plain soils but not for the poorly-drained soils. Where soil tests are made for the purpose of grouping soils into categories according to their capacity to supply available nitrogen, either NO_3-production or organic matter will give valuable information. However, NO_3-production was shown to give a more precise measure of soil nitrogen in well-drained Coastal Plain soils.

Nitrate production gave soil test information which was more closely correlated with field responses to nitrogen fertilization of corn than did soil organic matter. However, rainfall expressed as a drought index was also shown to influence nitrogen responses and when included as a second independent variable with NO_3-production in a multiple regression equation accounted for more response variation than either alone.

Since most well drained Coastal Plain soils supply only a small proportion of the total nitrogen needed to produce a crop of corn, the added precision provided by a nitrogen soil test in formulating fertilizer recommendations over that provided by a general knowledge of the soil type, past management and crop to be grown is not likely to warrant the added expense of the test. On the other hand, nitrogen soil tests may be useful in evaluating the effects of soil nitrogen on crops which have a low and more exacting nitrogen requirement than corn.

Microfilm $2.75; Xerox $6.80. 144 pages.

INFLUENCE OF NITROGEN AND PHOSPHORUS FERTILIZERS ON THE MORPHOLOGY AND PHYSIOLOGY OF SOYBEAN ROOTS

(Order No. Mic 61-2520)

Stanley Ralph Wilkinson, Ph.D.
Purdue University, 1961

Major Professor: Dr. A. J. Ohlrogge

Divided root system experiments with soybean secondary roots in the field and greenhouse showed that soybean roots branch profusely when they grow through localized placements of nitrogen plus phosphorus in a soil of medium fertility level, or in expanded vermiculite. Placements of nitrogen or phosphorus alone did not produce the same degree of branching. This root proliferation response was due to 1) a slightly increased density of lateral roots of a given order along the axis of the root penetrating the fertilizer band and 2) continued higher order branching of those roots growing in the region of the nitrogen and phosphorus placement. The latter effect accounts for the bulk of the root mass observed in the fertilized soil zone.

A hypothesis was developed to account for the observed positive interaction between nitrogen and phosphorus in producing the observed root proliferation. High levels of nitrogen in the root medium induce, by the uptake of the nitrogen, high levels of endogenous auxin within the root. High endogenous auxin promotes the formation of lateral root primordia, but does not promote the emergence of these primordia as lateral roots. When phosphorus is mixed with the nitrogen, it presumably helps overcome the inhibitory effects of high auxin content on lateral root emergence. Phosphorus presumably creates a favorable condition in the root for the utilization of carbohydrates in the production of energy-rich compounds and metabolites essential for lateral root development.

As the first step in testing this hypothesis, soybean roots were grown at various levels of nitrogen and/or phosphorus with other mineral nutrients maintained at an adequate level. These root systems were then extracted for auxins, and the extract tested for growth activity in two biological assays: the Avena coleoptile straight-growth test, and the soybean root tip growth test. In addition, chromatogrammed extracts of the roots were sprayed with p-dimethylaminobenzaldehyde (Ehrlich's reagent) and the area of the Ehrlich positive spots determined with a planimeter.

The growth hormone activity of chromatogrammed root extracts was increased by nitrogen fertilization of the intact roots. External concentrations of phosphorus in the root medium appeared to have little influence on the level of growth activity of the root extracts. There was some indication that phosphorus fertilization of roots without concurrent nitrogen fertilization may have decreased the level of growth activity in the extract. The growth activity in nitrogen fertilized root extracts was associated with tryptophan and a second unidentified substance. Growth activity of extracts from roots not fertilized with nitrogen was primarily associated with tryptophan. The unknown substance had a slightly higher Rf in isopropyl alcohol-water (8:2) solvent and a still higher Rf than tryptophan in 70% ethanol solvent. It gave a yellow color reaction with Ehrlich reagent. The identity of this compound was not established. Indoleacetic acid was not found in any of the chromatogrammed root extracts. This increased growth activity of extracts from nitrogen fertilized roots was apparently due to the differentially increased synthesis of this unknown substance. The pattern of growth activity at higher Rfs in the biological assays and color reactions with Ehrlich reagent support this conclusion.

A simple lateral root bioassay indicated that chromatogrammed extracts from roots fertilized at high levels of nitrogen promoted the initiation and emergence of more lateral roots on soybean root tips growing in culture mediums. This effect appeared to be largely confined to solutes running close to the solvent front in isopropyl-alcohol : water (8:2) solvent.

The results of auxin bioassays were consistent with the hypothesis that nitrogen fertilization enhances growth hormone synthesis in the roots. Increased numbers of lateral roots in the lateral root bioassay indicated a higher level of essential metabolites in roots fertilized at high nitrogen levels. Further critical experimentation is needed to confirm the role of phosphorus and the nature of nitrogen-phosphorus interaction in the stated hypothesis.

Microfilm $2.75; Xerox $6.40. 134 pages.

AGRICULTURE, ANIMAL CULTURE

REPRODUCTIVE PHYSIOLOGY OF THE MALE BOVINE

(Order No. Mic 61-2346)

Rupert Preynoessl Amann, Ph.D.
The Pennsylvania State University, 1961

The reproductive physiology of dairy bulls was studied with the following objectives: (a) to obtain quantitative information on testicular histology and spermatogenesis, (b) to determine the effect of frequency of ejaculation and the resultant sperm output on spermatogenesis, (c) to estimate testicular daily sperm production, and (d) to determine the effect of sperm output on the degeneration and resorption of germ cells in the testes and excurrent ducts.

Nine 2.5-year-old Holstein bulls were collected at six ejaculates per week (6X) for 5 weeks and then unilaterally vasectomized. After 18 days of recuperation, three bulls were placed on sexual rest (SR), three on two ejaculates per week (2X), and three on eight ejaculates per week (8X) for 20 weeks and slaughtered. Two minutes of restraint and three false mounts were used prior to each ejaculation. To provide a comparison between young and mature bulls, five normal, intact 5- to 9-year-old bulls also were studied. Three were slaughtered after collection at 6X to 8X while two were sexually rested.

Daily sperm output (DSO) on 6X for eight young and four mature bulls averaged 4.81 ± 0.35 billion and was highly significantly correlated with paired testes weight. The average DSO after unilateral vasectomy for three young bulls on 8X of 2.17 billion was 52% greater than that of 1.43 billion for three bulls on 2X. Even after unilateral vasectomy, sperm concentration and total sperm per ejaculate for 2X bulls were within normal limits; however, the values for 8X bulls were clearly deficient. It was concluded that to evaluate critically the effects of experimental variables on DSO and semen characteristics, semen samples must be collected at frequencies of at least 6X with intensive sexual preparation and at least 1 week must be allowed for stabilization of the extra-gonadal sperm reserves (EGR). The duration of spermatogenesis also should be considered.

The difference in the average number of testis sperm for young bulls (15.2 billion) and mature bulls (19.3 billion) was associated primarily with testis weight. The EGR of mature bulls averaged 33.9 billion per side as contrasted to 23.5 and 55.5 billion for the intact and vasectomized sides of young bulls. Ejaculation frequency and vasectomy did not affect the sperm content of the caput and corpus epididymis. For the 8X bulls, however, it was calculated that the content of the cauda epididymis just prior to ejaculation was 24% lower in young bulls and 39% lower in mature bulls than if they had been sexually rested. The cauda epididymis on the vasectomized side contained twice as many sperm as on the intact side. In eight of the nine bulls an average of 17.8 billion sperm accumulated just proximal to the site of vasectomy and in all nine bulls sperm were found distal to the point of vasectomy 23 weeks after surgery.

Differences attributable to testis locus, unilateral vasectomy, or frequency of ejaculation and sperm output were not detected in any of the histological evaluations. Seminiferous tubules comprised 77.1 ±0.5% and 72.6 ±1.0% of the testis volume in young and mature bulls. The relative frequencies of the eight stages of the seminiferous epithelial cycle were not affected by age and averaged 30.3, 16.1, 17.0, 10.4, 1.6, 6.3, 7.5, and 10.8% for 28 testes, respectively. In 7-μ. cross sections of Stage I seminiferous tubules the corrected numbers of A-spermatogonia, young primary spermatocytes, old primary spermatocytes, and spermatids averaged 3.1, 56.5, 54.0, and 201.6, respectively. Age differences were not significant. The average diameter of seminiferous tubules, corrected for histological shrinkage, was 271 μ. for mature bulls and 254 μ. for young bulls. Based on spermatogonia counts, a pattern for spermatocytogenesis was postulated. The divisions which result in In-, B-spermatogonia, and 16 primary spermatocytes did not appear to be synchronous, but rather occurred in two separate peaks. The extent of testicular degeneration of potential spermatozoa was 4% in young bulls and 19% in mature bulls.

Data on testis sperm counts and testis histology were used for separate estimates of daily testicular sperm production (DSP). It was estimated that the 12 bulls collected at 6X with intensive sexual preparation produced 11.4 ±0.6 billion sperm per day, but that only 43% of these were collected at this frequency. DSP was highly significantly correlated with both paired testes weight and DSO on 6X. Evidence was presented which suggested that nonejaculated sperm are resorbed in the cauda epididymis.

The results show that frequency of ejaculation does not affect spermatogenesis, but rather suggest that mature bulls are continuously producing about 13 billion sperm per day (17.7 million per gram of testis). However, because of the high rate of sperm resorption and additional losses by masturbation and during collection, it appears that it is impossible to collect more than about 50% of the sperm produced. Microfilm $2.80; Xerox $9.70. 215 pages.

REQUIREMENT OF AVIAN C'1 FOR FIXATION OF GUINEA PIG COMPLEMENT BY AVIAN ANTIBODY-ANTIGEN COMPLEXES

(Order No. Mic 61-2166)

Harold N. Benson, Ph.D.
University of Minnesota, 1960

It was reported previously that by the addition of normal chicken serum to heated or unheated ornithosis serum antibody, the titers were increased 2 to 8 fold. The normal chicken serum factor was heat labile and found in the water insoluble fraction which indicated the possible role of chicken C'1. It was suspected that guinea pig C'1 was not activated by the avian complex and that the reaction had never been initiated. This was substantiated by using chicken mid-piece as the sole source of C'1 and guinea pig endpiece as the source of C'2, C'3, and C'4 in both immune hemolysis involving chicken hemolysin and immune fixation involving turkey antibody-antigen complexes. This showed that the avian immune complexes formed sites which required chicken or turkey C'1 for the initial fixation step, after which guinea pig C'2, C'3, and C'4 could be utilized. To test the species aspect, various mammalian sera and pigeon serum were introduced as sources of C'1. None caused fixation except the closely related turkey, chicken or duck C'1.

Back titrations for guinea pig C'1 involving the ornithosis antibody-antigen complexes showed no evidence that guinea pig C'1 was used. This piece of evidence together with the addition of purified guinea pig C'1 to immune turkey complexes which resulted in no fixation of C'1 gave further proof that guinea pig C'1 was not involved in the initial fixation. It was recognized that the eublobulin fraction was a heterogeneous mixture of serum components. Therefore to produce a purer C'1, fractionation of chicken serum was carried out by continuous flow electrophoresis and when combined with guinea pig endpiece gave results similar to those employing chicken midpiece and guinea pig endpiece. Paper strip electrophoresis showed that this purified fraction of chicken C'1 contained at least two components. Further proof of the heterologous nature of the purified fraction was afforded when ducks produced antibody against the fraction. The results of this study indicated that an incompatibility has been shown to exist between turkey, chicken and duck antigen-antibody complexes and C'1 of guinea pig complement. This can be remedied by the substitution of species specific C'1 after which guinea pig C'2, C'3, and C'4 are fixed.

Microfilm $2.75; Xerox $4.00. 71 pages.

EFFECT OF FEMALE SEX HORMONES (ESTROGEN AND PROGESTERONE), THYROID GLAND (THYROXINE) AND VITAMIN B_{12} ON THE UTERUS.

(Order No. Mic 61-2279)

Mostafa Safwat Fahim, Ph.D.
University of Missouri, 1961

Supervisors: Dennis T. Mayer and
John F. Lasley

In this investigation an endeavor has been made to combine as nearly as possible all factors involved in creating an optimal intrauterine environment for the embryos during pregnancy. The results of this rather basic investigation utilizing rats should provide knowledge and methods applicable to the problem of embryonic losses in farm animals especially swine.

All animals were sacrificed on the 15th day of pregnancy. The data obtained included, (1) the number of corpora lutea (2) the number of embryos (3) the DNA concentration of the uterus.

The results indicate that the estradiol and progesterone mixture administered in a ratio of 1.2000 is a major factor contributing to a better intrauterine environment and thereby decreasing the embryonic death rate. The thyroid gland secretion may slightly enhance the effects of the female sex hormones whereas vitamin B_{12} may have no effect upon the intrauterine environment.

Microfilm $2.75; Xerox $7.20. 155 pages.

THE EFFECT OF SELECTION ON GENETIC VARIANCES AND COVARIANCES OF SOME TRAITS OF THE FOWL

(Order No. Mic 61-2471)

Gerald Winston Friars, Ph.D.
Purdue University, 1961

Major Professor: Dr. B. B. Bohren

The effects of selection on genetic variances and covariances were estimated in eight selected generations of a Dominant White broiler strain of chickens. These effects were evaluated through a study of the time trends in heritability and genetic correlation estimates. Findings revealed that decreases in estimates of genetic correlations were of greater consequence than decreases in estimates of heritabilities and multiple objective selection was suggested as a possible cause of these trends. Limited evidence indicated that genetic correlations between different pairs of traits were affected dissimilarly by environmental changes.

The development of a broiler strain of chickens with high juvenile body weight and low adult body weight was not deemed feasible by these data. Significant simultaneous improvement of these traits and egg production would require selection pressures of the latter which were greater than those used. Egg weight responded to the low mean annual selection pressure applied to this trait. The subjective score used for breast conformation was not adequate for studying time trends. The genetic correlations of this trait with the other traits suggest that positive selection for it should not impede improvement in the other traits studied.

Predicted and observed genetic gains were compared. A method of estimating the genotypic means of the population ("predicted genotypic base") was found to be more accurate and efficient than three other methods used.

Three types of heritability estimates were used for predicting genetic gains. The deviations of predicted from observed genetic gains did not show one type of estimate to be more accurate than the others. The observed gains in adult body weight could be predicted from the selection differentials on juvenile body weight and egg production through the use of an equation involving heritabilities and genetic correlations.

Microfilm $2.75; Xerox $7.40. 160 pages.

MAGNESIUM STUDIES WITH POULTRY

(Order No. Mic 61-2474)

Earl Edwin Gardiner, Ph.D.
Purdue University, 1961

Major Professors: J. C. Rogler, H. E. Parker

Two experiments were conducted to determine the chick's dietary magnesium requirement for optimal growth and livability. Other experiments were conducted to determine the effects of high levels of dietary phosphorus and sodium on magnesium deficiency symptoms and requirements. Two experiments were conducted to determine the

effect of added dietary magnesium on a fluorine toxicity. An additional experiment was conducted in an attempt to determine the hen's dietary magnesium requirement for optimal egg production and hatchability.

The results of the requirement studies indicated that the chick's dietary magnesium requirement was approximately 250 p.p.m. Subsequent experiments supported this conclusion. A magnesium deficiency was produced as early as three days after day-old birds were placed on treatment. The deficiency syndrome included slow growth, nervous tremors, gasping, convulsions and death. Plasma magnesium levels increased directly as the level of dietary magnesium was increased. The plasma from magnesium deficient chicks contained less cholesterol than the plasma from chicks receiving adequate levels of magnesium.

Increasing the dietary phosphorus level from 0.60 to 1.2 per cent accentuated a magnesium deficiency but did not measurably influence the dietary magnesium requirement. The high level of phosphorus increased mortality and decreased the weight gain of chicks deficient in magnesium. The level of dietary phosphorus had no consistent influence upon the level of plasma magnesium. Increasing the level of dietary phosphorus significantly increased the plasma inorganic phosphorus level. The level of dietary magnesium had no consistent influence on the plasma inorganic phosphorus level. A phosphorus deficiency was observed in chicks being fed a "purified" diet containing 0.70 per cent phosphorus with A.R. $CaHPO_4$ as the phosphorus supplement.

The addition of 0.2 per cent sodium to the basal diet by the addition of Na_2HPO_4 (maintaining constant phosphorus) appeared to accentuate a magnesium deficiency but did not measurably influence the amount of dietary magnesium required for maximal growth. However, the data indicated an increased mortality on the high level of sodium. The data also suggested that high levels of dietary sodium depressed plasma magnesium levels.

An interaction was observed between fluorine and magnesium. Fluorine, from sodium fluoride, at a level of 0.081 per cent of the diet consistently reduced growth. Magnesium, from magnesium carbonate, at a level of 0.2545 per cent of the diet did not have any significant effect upon weight gains of chicks; however, when both magnesium and fluorine were included in the same diet, growth was reduced more than with fluorine alone. Along with the growth depression the birds fed both these elements had difficulty in standing and had reduced bone ash.

Increasing the dietary level of phosphorus from 0.70 to 1.0 per cent did not have any significant effect upon this interrelationship.

The data on the hens' requirement of magnesium for egg production and hatchability were inconclusive due to the inability of the "purified" diet to maintain egg production even in the group receiving supplemental magnesium. The amount of magnesium in the hens' diet did influence the level of magnesium in their plasma, as well as the serum of the chicks hatched from eggs produced by these hens.

Data are presented on the magnesium content of several feed ingredients.

Microfilm $2.75; Xerox $4.80. 94 pages.

RELATIONSHIPS AMONG FACTORS AFFECTING THE QUALITY OF POULTRY

(Order No. Mic 61-2491)

James David Mitchell, Ph.D.
Purdue University, 1961

Major Professor: W. J. Stadelman

This study was planned to determine the relationships among factors affecting the quality of poultry. In order to obtain a wide variation of quality, chickens were injected with either diethylstilbestrol diacetate or polydiethylstilbestrol phosphate (P. S. P.), or fed rations containing potassium iodide or thiouracil. Pilgrim geese were injected with either diethylstilbestrol-methimazole, estradiol-17β monopalmitate, or polydiethylstilbestrol phosphate.

A fifteen milligram paste injection of diethylstilbestrol diacetate in seven week old fryers improved the dressing percentage and finish of birds at ten weeks of age. The finished score, a subjective measurement of finish, was significantly correlated ($P < .01$) with the percent fat and percent moisture in the carcass. As the percent fat increased and the percent moisture decreased, the quality of the carcass improved. The carcasses of the treated fryers showed a three percent decrease in moisture and a 9.28 percent increase in ether extract when compared with control carcasses. There were no differences among three methods for determining percent carcass moisture. The diethylstilbestrol diacetate treated fryers produced hyperlipemia and hypercholesteremia for about one week which were significantly positively correlated. However, normal plasma lipid and cholesterol levels were not found to be correlated.

The injection of ten or twenty milligrams of P. S. P. in day old chicks did not produce a significant improvement in carcass quality when compared with carcasses from control birds at six weeks of age. The twenty milligram dose resulted in sixty-five percent mortality and a significant decrease in growth.

A fifteen milligram injection of P. S. P. at four weeks of age produced a superior carcass finish from two through six weeks after treatment. Percent protein, percent moisture, and percent ash content of the carcasses from P. S. P. injected chickens appeared to be inversely related to ether-extractable content. Both plasma magnesium and plasma inorganic phosphorus increased with age, but showed no relationship to carcass quality. No correlation between percent plasma lipid and percent carcass fat was observed.

Carcass finish was significantly improved when either 0.3 percent or 0.4 percent thiouracil was supplied in the ration of growing chickens for four or ten weeks. However, when 0.05, 0.10, or 0.15 percent potassium iodide was supplied in the feed, no carcass improvements were noted. The percent moisture of all carcasses decreased and the percent ether extract increased with age. Thiouracil treatment from six to ten weeks of age increased ether extract 7.5 percent over the percent ether extract in the control carcasses. However, thiouracil supplied from six to sixteen weeks of age only increased carcass ether extract 3.8 percent over control carcasses. Hyperlipemia and hypercholesteremia were produced in birds treated with 0.4 percent thiouracil for ten weeks.

The carcasses from thirty week old control Pilgrim geese were found to contain an average of 7.1 percent less

moisture, 2.0 percent less protein, and 8.1 percent more ether extract than carcasses from geese treated with P. S. P. or diethylstilbestrol-methimazole, or estradiol-17β monopalmitate. A significant positive correlation was recorded at twenty-two, twenty-five and twenty-eight weeks of age between plasma cholesterol and total plasma lipid.

No differences were obtained among treatments or sex in the percent weight, ether extract or moisture of skin, meat or bone in the breast, back, wing, leg or thigh of eviscerated geese. The skin contained 32.03 percent moisture and 56.21 percent ether extract while the meat contained 67.74 percent moisture and only 10.24 percent fat.

Microfilm $2.75; Xerox $7.40. 159 pages.

GENETIC RELATIONSHIPS BETWEEN LACTATION MILK AND FAT YIELDS AND INCREASES IN PRODUCTION WITH AGE

(Order No. Mic 61-2306)

John Robert Schabinger, Ph.D.
North Carolina State College, 1961

Supervisor: James Edward Legates

Daughter-dam regressions and paternal half-sib analyses of variance and covariance were used to estimate the genetic relationships between lactation milk and butterfat yields and increases in production with age. Data from twenty-five Holstein breeder herds throughout the United States, made available through the Holstein-Friesian Association of America, and nine Holstein herds participating in the North Carolina Institutional Breeding Program were studied. Data from the first source covered a fifteen-year period and the data from the latter group were for ten years. Records from 3,078 cows with two lactations and 2,022 cows with three records were analyzed. All records were adjusted for age, season, and year of freshening.

Heritability estimates obtained by the intra-herd regression of 903 daughters with two records on their dams were slightly lower than the heritabilities based on the intra-herd paternal half-sib correlations. The pooled heritability estimate for the average milk production from two records was .35 $\pm$ .04, .29 $\pm$ .04 for the second record, and .30 $\pm$ .04 for the first record. Pooled heritability estimates for butterfat yields were .32 $\pm$ .04 for the average of two records, .22 $\pm$ .04 for the second, and .27 $\pm$ .04 for the first record. Although differences in heritabilities for the first two records and average of the first two records were found, these differences are not significant. Phenotypic variances for the average of two or three records were much smaller than the total phenotypic variance for individual lactation.

Estimates of heritability were obtained using 473 daughter-dam pairs for cows with at least three records. Pooled heritabilities for milk production were .33 $\pm$ .08 average of three records, .23 $\pm$ .06 average of two records, .30 $\pm$ .07 third, .22 $\pm$ .07 second, and .32 $\pm$ .06 first record. For butterfat yields, a similar trend was observed--lowered heritability for the second lactation and no additional increase in the estimate of heritability for averages of two or three records. Pooled heritabilities for butterfat were .40 $\pm$ .07 for the average of three records, .32 $\pm$ .05 for the average of two records, .31 $\pm$ .06 third, .13 $\pm$ .05 second, and .23 $\pm$ .05 first record.

Rate of increase in production with age was measured by the difference in mature equivalent yield of the second and third lactations as compared to the mature equivalent yield of the first lactation. The pooled estimates of heritability for increase in yield with age were one-half to two-thirds the heritability of the first lactation yield. The heritability for increase in milk and butterfat production between the first and second records was .18 $\pm$ .07, which was not significantly different from the heritabilities of .21 $\pm$ .06 for milk production and .22 $\pm$ .06 for butterfat production for the increase between the first and third lactations. Cows with two records showed a heritability for the increase in production--.20 $\pm$ .05 for milk and .22 $\pm$ .04 for butterfat.

Phenotypic correlations between the level of production in the first lactation and increase in yield for milk and butterfat were negative. These correlations were very similar for both groups of cows in this study. The relationship between the increase from first to second lactation and the first lactation ranged from - .37 to - .32 for milk and butterfat production. The relationship between the increase from first to third lactation and the first lactation was - .41 for milk and - .37 for butterfat yields.

A negative genetic relationship exists between the level of the yield in the first lactation and the rate of increase in yield between the adjusted M. E. production of the first and second lactations. The genetic correlations between the rate of increase in production between the first and third lactations and the level of yield for the first lactation require a larger number of observations than were available in the present study to be definitely established.

Microfilm $2.75; Xerox $4.60. 88 pages.

AGRICULTURE, FORESTRY AND WILDLIFE

THE RELATION OF SOIL AND OTHER SITE FACTORS TO FOREST COMPOSITION AND PRODUCTIVITY IN WEST TENNESSEE

(Order No. Mic 61-1479)

Edwin Atkins Hebb, Ph.D.
The University of Tennessee, 1960

Major Professor: Royal E. Shanks

In the Mississippi Embayment of west Tennessee the growth of five species of commercially valuable trees (southern red oak, Quercus falcata Michx.; white oak, Q. alba L.; tulip poplar, Liriodendron tulipifera L.; sweet gum, Liquidambar styraciflua L.; and cherrybark oak, Q. falcata var. pagodaefolia Ell.) was studied in an attempt to correlate it with soil and stand measurements and with species composition. The soils of this region are derived principally from loess, and also contain varying amounts of Coastal Plain sediments. The forests on these soils present a problem in the study of forest land productivity

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

because they are all-aged, and conventional methods of site index determination cannot be used.

Increment cores taken at intervals up the stem were used to produce a height growth curve from which a height-over-age figure could be read for each tree. Though the results were inconclusive for southern red oak and white oak, the method worked well with the other three species. Multiple regression analysis was used to test the association of tree growth with quantitative variables of the soil and the environment. Poor association of the nine variables with height growth was found in southern red oak and white oak. The coefficient of determination (R^2) was larger with tulip poplar (0.676); sweet gum (0.608); and cherrybark oak (0.707). In the five species the variables most commonly found significantly related to growth were topographic position and apparent surface drainage (both of which were classification variables rather than measurements). In multiple regressions some variables significant in simple regressions failed to contribute a significant amount. In tulip poplar soil depth to mottling was important in combination with topographic position and direction of exposure. In cherrybark oak basal area and apparent surface drainage were important together. In southern red oak and sweet gum, topographic position and apparent surface drainage were important together. In white oak only topographic position was significant.

With sweet gum there was a suggestion of a trend in the relation of productivity to the species composition of the surrounding stand. High indices were associated with frequency of occurrence of such species of wetter sites as river birch (Betula nigra L.) and cherrybark oak. Low site indices were associated with greater frequency of blackjack oak (Q. marilandica Muenchh.), black oak (Q. velutina Lam.), and post oak (Q. stellata Wang.). But these trends were obvious on the ground and the data were not strong enough to do more than illustrate them.

Productivity on different soil series varied greatly within the series. Soils of upland sites had low growth rates, and those of lowland sites had high growth rates, but ranges overlapped greatly so that soil series was only a very approximate forest productivity indicator. Correlation between tree grade and site was almost nil.

Microfilm $2.75; Xerox $6.20. 127 pages.

THE MAMMALS OF INDIANA — HISTORY AND CURRENT STATUS.

(Order No. Mic 61-2492)

Russell Eugene Mumford, Ph.D.
Purdue University, 1961

Major Professor: C. M. Kirkpatrick

On July 1, 1958, a 5-year project was initiated to investigate the mammals of Indiana. Previous work in this field was incomplete and spotty, and the status of most Indiana species was relatively unknown. Although considerable historical data were available, they had not been analyzed and summarized in a systematic fashion.

All pertinent, published references to Indiana mammals were abstracted to obtain historical information. Mammal specimens were collected throughout much of Indiana, and an attempt was made to visit all distinct physiographic units in order to capture the mammals present. The author collected and preserved mammal specimens from 62 of the 92 Indiana counties. Between July 1958 and July 1960, approximately 1,200 specimens were preserved and either donated to the United States National Museum or retained in the Wildlife Laboratory Collection, Purdue University. Extensive field work afforded many observations which were useful in preparing life history accounts of the various species.

For each of the 52 species of mammals now found in Indiana, information for the following aspects is brought up to date and summarized: a synonymy of scientific names formerly applied to Indiana forms; weights; measurements; pelage coloration; past history; present status and distribution; life history and ecology; economic importance; and list of Indiana subspecies. Also for each species, the known distribution in Indiana is shown by an outline map which has been modified to show the counties from which specimens have been preserved.

It is evident that more work is required before the ranges, natural history, and complete status of Indiana mammals can be determined. One area that requires intensive study is the habitat requirement of each form. Additional data on reproduction, populations, and diseases would permit a better evaluation of the importance of most of our native mammals. Most current ranges need to be defined more completely in order that future shifts in distribution may be detected and followed.

Microfilm $3.90; Xerox $13.75. 301 pages.

VARIATION IN LOBLOLLY PINE (PINUS TAEDA L.)

(Order No. Mic 61-2307)

Eyvind Thorbjornsen, Ph.D.
North Carolina State College, 1961

Supervisor: Dr. Bruce J. Zobel

The main part of this study is concerned with natural variation of loblolly pine, although data were also obtained from greenhouse tests and a single provenance test area. A large number of morphological characteristics were investigated; these characteristics can be divided into four main groups: needle, seed, cone, and wood. Also, seed germination and seedling development were studied.

The study of natural variation consists of three parts. In 1957 five areas with 75 trees were sampled on the coastal plain of North Carolina; and in 1958 seven areas totaling 105 trees were studied from the coast to the western extreme of the species range. At the same time cooperators shipped in samples from the entire range of loblolly pine, covering eighteen locations and including 270 trees. Approximately 41,000 observations were made on this material, the data were analyzed according to a nested analysis of variance by using an IBM 650 electronic computer, and further examined by a multiple range test.

More than thirty different morphological and physiological characteristics were investigated. In one respect all these variables behaved alike; in natural populations, greenhouse tests, and provenance tests a large proportion

of the total variation is accounted for by the tree to tree variation. Rather than being discouraged by the tremendous among-tree variation in loblolly pine, which tends to conceal differences which may be present among populations, the tree breeder should take advantage of the opportunity to improve this species by individual tree selection.

Of the thirteen morphological characteristics which showed highly significant differences among areas in the analysis of variance of natural populations, the majority did not show any regional trend. "Genetic drift" may thus be a factor in differentiation of morphological characteristics in loblolly pine. Seed form, seed coat thickness, cone weight, cotyledon number, and stomata frequency gave good evidence of regional variation patterns.

The most outstanding character is seed coat thickness which varies in a clinal pattern. There is a strong increase in seed coat thickness from the western to the eastern part of the range. Similarly, all the coastal plots have higher mean values than the corresponding inland plots. Thus, there is high correlation between seed coat thickness and the precipitation - evaporation ratio. The theory that seed coat thickness has an adaptive value has been discussed in some detail, and it definitely appears as if this variation pattern is the result of a selective force which exerts its pressure according to gradual changes in the climate.

A similar clinal distribution pattern was found for stomata frequency. The other three characteristics, seed form, cone weight, and cotyledon number, exhibited different patterns of distribution and indicate that the different morphological characteristics have a more or less unique variation pattern. Cotyledon number, for example, was high in the central and northern part of the range, while seedlings originating from the extreme west, south, southeast, and northeast had relatively few cotyledons.

In the present study no morphological characteristic was found to vary according to a north-south clinal pattern which most likely is present for temperature and photoperiodic races. There is a strong indication that some important geographic variation patterns in forest tree species may not be detected by morphological sampling of natural populations or short-term greenhouse tests; well planned and properly executed provenance tests are usually required to detect all physiologically significant differences among populations.

On the other hand, morphological studies of natural populations add valuable information to data obtained from seed source tests. Thus, significant differences in growth between sources of the east-west transect, representing mainly one temperature and photoperiodic zone, have not been determined in provenance tests. The present investigation has revealed good evidence that a clinal pattern from east to west and from coast to inland is present for at least one characteristic, seed coat thickness; a similar trend is present for stomata frequency.

Microfilm $2.75; Xerox $9.00. 197 pages.

GROWTH AND DEVELOPMENT OF FOUR NORTHERN CONIFERS UNDER LONG AND NATURAL PHOTOPERIODS IN WISCONSIN AND FLORIDA

(Order No. Mic 61-2162)

Richard Franklin Watt, Ph.D.
University of Minnesota, 1961

Large and costly transplant stock is required for successful reforestation of the 8 million acres of denuded lands in Minnesota, Michigan, and Wisconsin. Reduction in cost of stock would hasten the reforestation of this acreage. Extended photoperiods have produced large seedlings in a short period in greenhouses, but short growing seasons in northern nurseries circumscribe use of long photoperiods.

An alternative is to sow northern conifers in a southern location with a long growing season supplementing the short natural photoperiod with artificial light, thus delaying the onset of dormancy until the end of the growing season.

White and red pine and white and black spruce were seeded in northern Florida (30° N. lat.) and Wisconsin (45° N. lat.). The growing season in Florida is 266 days compared to 125 days in Wisconsin. At each location, seedlings were grown under extended photoperiod of 20 hours and natural photoperiod.

Observations of growth and development were made biweekly. At the end of the second season plants were harvested and heights, weights, and diameters were determined.

Despite treatment with fungicides, nematocides, and heavy fertilization, survival of red pine in Florida was poor. Survival of the other three species was fair to good with better survival under extended photoperiod than under natural day. A second series of beds with improved drainage gave excellent survival the second season.

Two-year seedlings produced in Florida under long day compared favorably with minimum standards for northern-grown transplants. Spruces were severely dwarfed by the natural day of Florida, the pines less severely.

Under long day, seedlings in Florida grew throughout the growing season. The first season, white pine under long day did not set terminal buds until late October; the second year buds were set in June, but many seedlings made a second flush under long day. Red pine in both treatments set buds at the same time with many seedlings under long day flushing a second time. Spruce seedlings under long day generally grew until well after the cessation of long-day treatments; some spruces set terminal buds early in the second season, but flushed again under long day. Both spruces under natural day set terminal buds early both seasons and did not produce a second flush.

Except for red pine under natural day, all species under both treatments in Florida flushed normally at the start of the second season, despite the short period of winter chilling. Initiation of growth in spring is a function of temperature rather than photoperiod, for flushing occurred simultaneously for a given species in both treatments.

Growth in Wisconsin was not appreciably greater under long day than under natural day the first season. The second season, many pine seedlings of both species under extended photoperiod made a second flush in August, producing larger plants than under natural day. Both spruces under long day grew without interruption the second season

until shortly after cessation of long-day treatment, producing considerably larger seedlings.

Long day in northern nurseries holds promise for treatment of spruce during the second year in the seedbed to reduce the percent of seedlings that must be culled before transplanting in the nursery.

Gross morphological changes were observed in the North and South. Spruce under extended photoperiod in both locations had more lateral branches than spruce under natural day due to closer spacing of branches and a longer main stem. White pine shoots produced by late flushing in Wisconsin bore a large number of juvenile-type leaves. White pine grew fascicles with more than the typical five needles under natural day in Florida. Root growth of all species was increased by long day in Florida but not in Wisconsin. Microfilm $2.75; Xerox $8.40. 185 pages.

AGRICULTURE, PLANT CULTURE

PHYSICAL IMPEDANCE AS A FACTOR LIMITING PLANT GROWTH AND ROOT PENETRATION INTO COMPACT SUBSOILS

(Order No. Mic 61-2357)

Frederick Yates Borden, Ph.D.
The Pennsylvania State University, 1961

Cavode clay and Hagerstown clay subsoils were used in an attempt to discover the importance of physical impedance to root and plant growth in compact subsoils. By a technique developed to manufacture artificially compacted soil cores, cores of uniform bulk density were obtained in the bulk density range from 1.4 g./cc. to 1.9 g./cc. The cores were partially sealed with paraffin against contamination by the outside atmosphere. Tomato plants were grown in the cores from four to eight weeks at a moisture tension of six cm. of water.

Calcium peroxide was used to supplement soil oxygen while starch was used to decrease the oxygen content. Calcium peroxide was detrimental to plant growth in all concentrations used; 0.25 to 2% by weight. Starch concentrations below 0.16% by weight were not usually detrimental to plant growth and in some cases were beneficial. Aeration of soil cores receiving neither starch nor calcium peroxide was sub-optimum, but not completely limiting plant growth and root penetration into the soil.

The decomposition of calcium peroxide to yield oxygen was characterized by an initial rapid decomposition rate followed by an extended slow rate. The detrimental effects of calcium peroxide were either caused by the toxic effect of the intermediate reaction product, hydrogen peroxide, or by the toxic effect of excessive oxygen.

Oxygen diffusivity was measured by an electrochemical method. It was very low as a result of the lack of air space in the soil cores. Oxygen diffusivity was not related to bulk density.

Physical impedance was found to be an important factor influencing plant growth and root penetration into compact subsoils. A bulk density between 1.4 and 1.5 g./cc. limited root growth into the Cavode subsoil while a bulk density of 1.6 g./cc. restricted root growth into the Hagerstown subsoil. The pore volume of the Cavode subsoil at various bulk densities was concentrated in pores with smaller diameters than for the Hagerstown subsoil at the same bulk densities. Microfilm $2.75; Xerox $5.00. 97 pages.

HYDROLOGIC BALANCE OF THREE SOILS SUPPORTING NATURAL HARDWOODS, PLANTED RED PINE, AND OLD FIELD PLANT COMMUNITIES IN CENTRAL PENNSYLVANIA.

(Order No. Mic 61-2361)

William Richard Byrnes, Ph.D.
The Pennsylvania State University, 1961

An investigation was conducted during the period August 1958 to December 1959 to determine the hydrologic balance of three soils - - Hagerstown, Calvin-Edom, and Dekalb - - presently supporting a large acreage of natural hardwoods, planted red pine, and old field plant communities in Centre and Huntingdon Counties, Pennsylvania.

Field investigations included measurements of simulated rainfall infiltration and soil moisture and temperature regimen. Permeability of the various horizons of the soil profiles under each cover type were determined on core samples and subsamples of these cores were subjected to physical and chemical analyses.

Other than surface organic matter accumulations and rooting habits, few differences were noted in physical properties of the soil profiles under old field and red pine cover. The hardwood soil profiles, however, differed materially from the old field and red pine profiles, with organic matter content, soil porosity, and per cent of water stable aggregates being higher and bulk density lower in the upper horizons under hardwoods.

Average wet-run infiltration capacity under red pine was 33 per cent higher than that under old field cover, while infiltration under the undisturbed hardwoods exceeded that under red pine by only 7 per cent. Infiltration in addition to being higher was also less variable under red pine and hardwoods than under old field cover.

Vegetational influences affecting the percolation of water through the soil profile were exerted primarily on the porosity factors of the soil, with non-capillary porosity being more closely related than total porosity or aggregate stability to variations in soil permeability. Soil permeability was considerably higher in the surface horizons and only slightly higher in the lower A and upper B horizons under both red pine and hardwoods than under old field cover.

Total soil moisture depletion from the 0-33 inch depth during the drying cycle, April 1 to October 31, 1959, was approximately 81 per cent higher under red pine than under old field cover and 68 per cent higher under red pine than under hardwoods. Total depletion comparisons among hardwoods and old field cover, limited to the Hagerstown and Dekalb soils where conditions were more comparable, reveal that the total moisture loss under hardwoods was about 31 per cent greater than that under old field vegetation. All depth levels, down to 33 inches, were depleted of moisture under the tree covers, while little change was

noted in the layers below 12 inches under the old field plant community.

Temperature fluctuations were quite uniform among the 3 soils, but a narrower range, correspondingly less fluctuation, was observed with increasing depth. The difference between maximal and minimal temperatures at corresponding depths was greater under old field cover than under either tree cover. The greater annual range in soil temperature under old field vegetation was related primarily to the higher maximum temperatures, which occurred during the summer months.

Within the limitations of this study, it is evident that the greatest potential hydrologic yield occurs under the shallow-rooted old field vegetation and the least under the 20-year old planted red pine, while the hardwoods are intermediate. For flood prevention, the soil profiles under both tree covers are more effective than the old field in providing water intake and storage opportunities.

Microfilm $2.75; Xerox $7.60. 165 pages.

A STUDY OF THE EFFECT OF TEMPERATURE LEVELS OF GERMINATION ENVIRONMENT ON CHEMICAL AND PHYSICAL CHARACTERISTICS OF COTTON SEEDLINGS

(Order No. Mic 61-2294)

Meryl Naeve Christiansen, Ph.D.
North Carolina State College, 1960

Supervisor: Robert Parker Moore

Investigations were made concerning the influence of level and duration of sub-optimum germinating temperatures applied to pre-germinated and non-pregerminated cotton seed upon subsequent seedling development at favorable temperatures, and upon in vivo hydrolysis of lipid. Additional studies were conducted to determine the activity of lipid-hydrolyzing enzymes of dry, dormant seed, and the effect of temperature on the in vitro activity of lipase and esterase enzymes, and upon the activation of "proto-lipase" of imbibed seed.

The growth of seedlings at 75°F in terms of radicle and hypocotyl elongation, dry weight accumulation, and emergence after subjection to temperatures of 50, 54, 58, and 62° was inversely proportional to the level of cold treatment. At temperatures of 50 and 54° for three, six, and nine day durations the six and nine day exposures caused greater growth inhibition than the three day durations in terms of subsequent seedling development at 75°. The sub-optimum temperatures of 50-62° for three, six, or nine days influenced less adversely the seedling development of non-pregerminated seed than of seed in which germination was initiated at 75° for 24 hours. Six and nine day durations of 58 or 62° were less injurious to pre-germinated plantings than three day durations.

As measured by reduction in lipid content and free fatty acid increase, the minimum temperature for the in vivo hydrolysis of oil within non-pregerminated cotton seed was found to be between 62 and 66°F, and that for seed pregerminated at 75° for 24 hours prior to cold treatment was between 58 and 62°. As much as 50% of the total lipid is depleted within nine days in actively germinating seed held at 66°. No increase in free fatty acid was found in high quality cotton seed that was subjected to germinating conditions at 50, 54, or 58° for as long as nine days.

Lipase activity was not evident in fat-free extracts from dry, dormant, high quality seed when triolein was used as a substrate. Slight activity, in terms of oil hydrolysis, was found if cotton seed oil was used as substrate; however, this activity was possibly due to activity of esterase enzymes which were present in the defatted powder preparations. Considerable lipase activity was present in fat-free powders of two-day-old seedlings. The activation of "proto-lipase" of cotton seed is inhibited at temperatures below 65°F. In vitro lipase activity is inhibited at temperatures near 51°. A sharp rise in activity occurs at 65°. Esterase preparations from dry cotton seed rapidly hydrolyzed 2-naphthyl acetate at 36°.

Microfilm $2.75; Xerox $3.80. 69 pages.

GREENHOUSE STUDIES ON ORGANIC MATTER, PHOSPHORUS, SOIL COMPACTION, AND SOIL MOISTURE AS RELATED TO STRAWBERRY GROWTH.

(Order No. Mic 61-2179)

William Beck Collins, Ph.D.
Rutgers University, 1961

Major Professor: Dr. C. R. Smith

Three factorial experiments, involving studies of organic matter, phosphorus, compaction, and moisture regime treatment of a loam soil and their relationships to strawberry growth, were conducted in 1960 at Rutgers * The State University.

The design called for two levels of organic matter, untreated soil and soil plus four tons per acre of a dried manure product. Phosphorus was studied at three levels, 80, 160, and 240 pounds per acre of available P_2O_5. The experimental soils were compacted to bulk densities of 1.32, 1.43, and 1.56. The moisture regimes were such that soil moisture was permitted to fluctuate between field capacity and moisture tensions of 0.50 or 0.75, 2, and 10 atmospheres.

Addition of manure caused significant reductions in leaf area, petiole length, dry weight of leaves and petioles, root area, root volume, and root dry weight. Growth reductions were most significant at the low moisture tensions and were associated with severe nitrogen deficiency symptoms in the foliage. Denitrification processes and accumulations of toxic compounds in the soil appeared to be responsible for the detrimental effects of high organic matter at low tensions. High organic matter caused a slight growth increase in the 10-atmosphere tension regimes. Organic matter had little effect on runner tip growth in the first three weeks.

Phosphorus at the highest level caused significant increases in leaf area, petiole length, dry weight of leaves and petioles, length of main roots, number of secondary roots, root area, volume, and dry weight, and lateral root growth.

Compaction of the soil to an apparent bulk density of 1.56 caused significant reductions in leaf area, petiole

length, dry weight of leaves plus petioles and crowns, lateral root development, and root dry weight. Root penetration and proliferation of the soil were retarded. Growth reductions due to the highest bulk density were greatest in the high organic soil. Plant growth was increased by compaction of the soil to an apparent bulk density of 1.43.

Maximum strawberry growth was correlated with a mean oxygen diffusion rate of 25×10^{-8} gm. cm.$^{-2}$ min.$^{-1}$. Secondary root growth was favored by rates between 45 and 55×10^{-8} gm. cm.$^{-2}$ min.$^{-1}$.

Growth of top and roots was decreased as soil moisture stress increased. Leaf area, petiole length, dry weight of leaves and petioles, root number, and root dry weight were significantly decreased at the 10-atmosphere tension. At the same time root length and lateral root growth were significantly increased.

In the first three weeks of growth from the runner tip stage, the rate and amount of top growth were controlled largely by moisture supplied to the mother plant. Growth was significantly decreased as moisture stress to the mother plant was increased. Leaf size and root growth were largely independent of influence by the mother plant. The initial number of main roots formed in the first three weeks of growth was independent of moisture tension in the rooting medium. Main root elongation and lateral root growth were significantly decreased by soil moisture tensions of 0.5 and 10 atmospheres during this same period. The dry soil effected the most significant reductions in root growth. Variations in soil moisture tension in the rooting medium had no influence on top growth of the young runner except for leaf size. Optimum growth of the young runner occurred at a moisture regime tension of 2 atmospheres. Microfilm $2.75; Xerox $7.20. 151 pages.

FACTORS AFFECTING UPTAKE AND MOVEMENT OF CERTAIN SUBSTANCES IN THE STRAWBERRY PLANT

(Order No. Mic 61-2475)

Ralph Garren, Jr., Ph.D.
Purdue University, 1961

Major Professor: R. G. Langston

The distribution and accumulation of root absorbed phosphorus-32 has been followed throughout all the several plant parts of mother plants and the runners and attached daughter plants in the commercial strawberry (Fragaria virginiana x F. chiloensis) under two contrasting conditions. When the access to P-32 was via the mother plant only, uptake and distribution occurred via roots of the mother plant and in an acropital direction to all attached daughter plants via the runner attachments. P-32 was found in greatest quantities in the plant parts representing the most bulk but exhibited highest specific activity (CPM/gram) in parts making most active growth. When access to P-32 was via the first formed daughter plant of the first formed runner, absorption was via the roots of the daughter plant and distribution in both an acropetal and basipetal direction via runner attachments. Basipetal movement to the mother plant occurred and P-32 was redistributed from the mother plant via runner attachments in an acropital direction to all nontreated runners. Movement in this direction was slight but definite.

It was shown that lateral feeder rootlets are the most effective portions of the root system in the absorption of phosphorus-32 and that formation of these rootlets is somewhat dependent upon auxins synthesized in the leaves and crown. IAA can substitute for the effect(s) of the leaves. Effects of adenine, kinetin, and indolebutyric acid on development of lateral rootlets were also studied. Combinations of indolebutyric acid and kinetin were found to be effective in producing an earlier and more prolific development of lateral rootlets on young transplants. This has been tested and found to be effective under field conditions.

It was determined that the photosynthetic fixation by different portions of the trifoliate leaves and effects due to defoliation did not result in differences of ability of the leaves to fix $C^{14}O_2$. Leaves of different ages were found to differ in $C^{14}O_2$ fixing ability.

During a four day period of P-32 uptake by intact fruits, it was determined that specific activity of young fruits at a time of high auxin level within the achenes was higher than that for older fruits. Old fruits accumulated more activity in total due to a decided difference in bulk.

Auxin administered to fruits on plants receiving P-32 accumulated more P-32 in the achenes than did fruits not treated with auxin, however under the conditions of the experiment these differences although sizeable were not significant. A similar experiment with zinc-65 was not productive of results. Temperature effects during the experiment were perhaps detrimental.

Microfilm $2.75; Xerox $6.20. 126 pages.

THE RESPONSE OF ALFALFA TO DEFOLIATION BY GRAZING ANIMALS AS COMPARED TO CLIPPING

(Order No. Mic 61-2299)

Dorsey McPeake Gossett, Ph.D.
North Carolina State College, 1961

Supervisor: Douglas Scales Chamblee

The response of alfalfa to rapid and gradual defoliation by grazing during the summer growing season and after frost in the fall as compared to clipping was studied in seven grazing experiments. Grazing periods of one and five days were employed in the summer grazing studies, while one, five and fifteen day grazing periods were employed in the fall grazing experiments. Plant responses were studied, and no attempt was made to measure animal performance. Hand shears were used to simulate grazing in greenhouse studies in order to study defoliation periods of one, five and fifteen days at both the bud and one-tenth bloom stage of maturity.

In the summer grazing studies the five-day grazing periods, which were initiated when the alfalfa reached the one-tenth bloom stage of maturity, resulted in a detrimental effect on subsequent yields. After grazing for three consecutive harvests, the yields at the following harvest were 25 to 30 percent lower than the yields of alfalfa which had been clipped at the three previous harvests. Smaller reductions in yield occurred if fewer harvests were grazed.

Some recovery in yields occurred when the harvests following grazing were clipped. This indicates that alternate harvests can be grazed over a five-day period with only a small detrimental effect on yields.

Trampling damage resulted in a 24 percent thinning of the stand when each of three consecutive harvests were grazed over a five-day period. In cases where the soil moisture was high, more trampling damage resulted.

In general, grazing the total forage in one day at each harvest resulted in residual yields and plant densities that were similar to yields and plant densities obtained from clipping.

In the fall grazing studies, lower yields were obtained at the first harvest the following spring if the aftermath growth, which accumulated between the last summer cutting and frost, was removed by grazing. The difference in yield at the first spring harvest was about equal to the amount of aftermath growth available for grazing. The alfalfa recovered from grazing in the fall by the second harvest the following year; thus, the total annual production was not changed by grazing after frost.

The different grazing periods studied after frost had similar detrimental effects as clipping on yields at the first spring harvest. No clear-cut change in plant density occurred due to grazing or clipping after frost.

Under simulated grazing conditions alfalfa defoliated by one clipping at the end of a defoliation period yielded more than when the plants were gradually defoliated throughout five or fifteen-day defoliation periods. There was also a trend for greater root development under clipping on the last day of the defoliation period than under gradual defoliation throughout the period. Larger herbage yields and root development occurred when the alfalfa was harvested at the one-tenth bloom stage than at the bud stage.

Microfilm $2.75; Xerox $5.60. 113 pages.

STUDIES ON THE NUTRITION OF BARTLETT PEAR TREES (PYRUS COMMUNIS L.) AND FIRE BLIGHT (ERWINIA AMYLOVORA, BURR.).

(Order No. Mic 61-1180)

Lowell Nelson Lewis, Ph.D.
Michigan State University, 1960

Major Professor: A. L. Kenworthy

Bartlett pear trees were grown in a nutrient solution sand culture at various levels of nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc, boron, manganese, copper, and molybdenum during the 1958, 1959 and 1960 seasons. These trees were used to study the effect of nutrition on the mineral composition of the leaves, on the free amino acid levels in the growing tips and older leaves, and on the susceptibility of pear trees to fire blight.

As an auxiliary study, the causal organism of fire blight, Erwinia amylovora, Burr. was grown in synthetic media to ascertain its ability to utilize natural and synthetic amino acids and amides as a source of nitrogen. Various other synthetic amides were tested for their bactericidal effect.

The studies on the effect of nutrition on the mineral composition of the leaves showed that decreasing the amount of an element in the nutrient solution resulted in a corresponding decrease in the leaf concentration of that element in all cases except iron, zinc, copper, and molybdenum. Increasing the amount of an element in the nutrient solution increased leaf concentration except for calcium, zinc, and molybdenum. In a few instances the concentration of one element seemed to be dependent on the concentration of another. Magnesium, calcium, and potassium concentrations seemed to be closely interrelated. Potassium and phosphorus showed an indirectly proportional relationship. There were other instances of low magnitude elemental interactions.

The free amino acid composition of the growing tip of a pear tree also seemed to be related to the nutrient element composition of the leaves. Increasing or decreasing total leaf nitrogen resulted in a similar change in the free amino acid concentration. High levels of phosphorus or potassium in the leaf were associated with an increase in total free amino acids similar to that found for trees high in nitrogen. Either increasing leaf boron or decreasing leaf magnesium resulted in amino acid levels equally as low as those in the minus nitrogen trees.

The free amino acid levels were also studied in the mature leaves from non-growing shoots of trees grown in solutions deficient in nitrogen, phosphorus, potassium, iron, and boron. Minus boron leaves contained more total amino acids than the check leaves, but low potassium leaves accumulated the highest total free amino acid level. Arginine accumulated only in the leaves deficient in phosphorus.

The most promising effect of nutritional environment on the susceptibility of pear trees to E. amylovora was found on trees grown in a high level of calcium. Neither the plus calcium nor the minus boron trees became infected with the bacteria. Those trees deficient in phosphorus or iron as well as the check trees appeared to be quite resistant. Trees grown in high levels of molybdenum, copper, potassium and nitrogen appeared to be the most susceptible to an E. amylovora infection and spread.

Studies on the bacteria, itself, showed that E. amylovora readily utilized aspartic acid, glutamic acid, asparagine, glutamine, beta-alanine, and gamma-amino butyric acid as a sole source of nitrogen in a synthetic culture medium. However, there appeared to be no correlation between the foliar concentration of the individual amino acids or the total amino acid level and the susceptibility of the tree to a fire blight infection.

Tests on the bactericidal effect of certain synthetic amides indicated that bromoacetyl valinamide may be a good bactericide for E. amylovora. This compound gave better control than agrimycin under the conditions of this experiment and showed no phytotoxic effect on the tree.

Microfilm $2.75; Xerox $4.80. 94 pages.

SUDANGRASS AND PEARL MILLET DEVELOPMENT AND PRODUCTIVITY AS INFLUENCED BY CUTTING HEIGHTS

(Order No. Mic 61-2389)

David Arthur Mays, Ph.D.
The Pennsylvania State University, 1961

Most of the perennial grasses and legumes used for pasture in the humid East produce only limited amounts of forage during July and August. If the permanent and rotational pastures of this region are to be stocked to full capacity during their favorable periods of growth, some form of supplementary feed must be available during periods when such pastures are not producing adequate amounts of forage.

Sudangrass, Sorghum sudanense (Piper) Stapf., and pearl millet, Pennisetum glaucum (L), are often grown in the eastern United States for mid-summer supplementary forage. These grasses are grazed directly by livestock or harvested with a forage chopper for green feeding.

Field experiments were conducted in 1959 and 1960 at University Park, Pennsylvania, to study the effect of differential cutting heights on the growth, development and yield of these two species. Two varieties of sudangrass, Piper and Greenleaf, and two varieties of pearl millet, Gahi 1 and Common, were grown with zero and 200 pounds of fertilizer nitrogen per acre.

Each time the forage reached a height of 18 to 20 inches, it was cut back to 2, 4, 6, or 8 inches above the soil surface and sampled to determine dry matter yields per acre. After each harvest the forage was analyzed chemically for crude protein and crude fiber. After the first harvest, tiller counts, measurements of new leaf growth, and refractometric determinations of sugar in the stubble sap were made.

In addition, two greenhouse experiments were conducted; the first to investigate the effect of differential cutting treatments on subsequent plant vigor, and the second to study recovery rates of sudangrass and millet plants grown in the absence of light after being cut at different heights.

The results of the various experiments can be summarized as follows:

1. The vigor of sudangrass and pearl millet was reduced more severely by 2- and 4-inch cutting treatments than by 6- and 8-inch treatments.
2. Significantly more tillers were initiated by sudangrass and pearl millet after being cut at a 2-inch height than at 4-, 6-, and 8-inch heights.
3. The sugar content of sap from the basal stubble of these species was reduced more by severe than by moderate defoliation.
4. Sudangrass and pearl millet grown in the absence of light after cutting recovered at the same rate regardless of cutting height.
5. It appears that differences in vigor and recovery rate after cutting were related to differences in the amount of photosynthetic tissue remaining on plants cut at different heights.
6. Differential nitrogen fertilization did not change the response of sudangrass and pearl millet to different cutting treatments.
7. A greater number of harvests per season resulted when these species were cut at 6- and 8-inch heights, but the amount of forage removed per harvest was so small as to preclude adoption of this as a management practice.
8. The highest yields of forage produced prior to the first killing frost were from plots harvested at heights of 2 or 4 inches throughout the season; however, the total production of dry matter, including that removed after frost, was not significantly affected by variations in cutting heights.
9. Lowering the cutting height of forage from 8 to 2 inches increased its crude fiber content and decreased its percentage of protein and T.D.N.
10. The protein and T.D.N. content of sudangrass and pearl millet was higher at the first cutting than at later cuttings.

Microfilm $2.75; Xerox $4.60. 89 pages.

A STUDY OF THE ROOT AND TOP GROWTH OF SEVERAL FORAGE SPECIES AS INFLUENCED BY NITROGEN AND IRRIGATION TREATMENTS

(Order No. Mic 61-2390)

William Hugh Mitchell, Ph.D.
The Pennsylvania State University, 1961

The purpose of this investigation was to determine the effect of nitrogen fertilization and supplemental irrigation on the root and top growth of several forage species. Ladino clover, alfalfa, birdsfoot trefoil and orchardgrass were each grown alone and each legume in association with orchardgrass. Each of the treatments was subjected to two nitrogen levels, consisting of 0 and 150 pounds of nitrogen applied annually in 50-pound increments, and four irrigation treatments. The latter involved the application of water in 1-, 2-, and 4-inch quantities to obtain the same total amount of water annually. Comparisons were made with a control which received only natural rainfall amounting to 59%, 115%, and 98% of the long time mean for the years 1957, 1958, and 1959, respectively. Supplemental irrigation treatments were used in 1957 and 1959 at the rate of eight and four inches per season.

Yield responses were measured by mechanically harvesting dry matter samples at a two-inch height and by removing, annually, six-inch root cores to a depth of twenty-four inches. Each root core was divided into four inch depths and each depth analysed for root content. Adsorption of methylene blue by the washed root was used as a relative measure of their activity. By calculation, the adsorption of methylene blue, per gram of dry root tissue, was determined. This value provided a relative measure of root activity.

Of the several forages and forage mixtures studied alfalfa and alfalfa-orchardgrass were the most persistent and high yielding. They were more productive when grown under conditions of natural rainfall than the other mixtures were when treated with supplemental water.

Birdsfoot trefoil and orchardgrass were not highly responsive to supplemental irrigation due, in part, to the vigorous growth each made with the return of normal rainfall after a prolonged drought. This compensated for dry matter gains resulting from supplemental water applied during periods of drought.

Significant differences in top growth were associated with methods of applying supplemental water. In 1957, two inches of water applied at each irrigation was superior to

one or four inches. In 1959, one inch was superior to either the 2- or 4-inch treatments.

Orchardgrass responded very significantly to nitrogen applications with increases of 89, 74, and 107% over the no-nitrogen treatments for the three-year period. The stands of nitrogen treated orchardgrass, however, were seriously reduced following the second and third harvests in 1958 and 1959. Stand reductions were most severe where the height of cut was less than two inches. This suggests that a nitrogen - height of cut interaction was associated with loss of stands.

A methylene blue adsorption technique for use in making relative root activity measurements is described. Methylene blue adsorption and, to a lesser extent, dry weight measurements show that nitrogen fertilization was generally associated with smaller root systems. Nitrogen, however, increased the adsorption of methylene blue per gram of root tissue, a value referred to as root activity. Root activity increased with increasing root depth and was generally greater for the fibrous-rooted than for the tap-rooted species.

Supplemental irrigation decreased root growth as measured by methylene blue adsorption and root weights. Irrigation was found to increase growth, however, during the year following treatment.

Although nitrogen fertilization and irrigation were associated with decreases in root weights, nevertheless these factors contributed to very significant increases in top growth. Increases in root activity resulting from irrigation and nitrogen fertilization suggest an explanation for increased dry matter yields with smaller root systems.

Microfilm $2.75; Xerox $5.60. 112 pages.

AN ADDITION REACTION OF THE PLANT GROWTH HORMONE

(Order No. Mic 61-2497)

Thomas Henry Plummer, Jr., Ph.D.
Purdue University, 1961

Major Professor: A. Carl Leopold

Experiments were carried out to determine the ability of indoleacetic acid (IAA) and 5-hydroxyindoleacetic acid (HIAA) to condense with o-quinones generated in polyphenol oxidase-diphenol reaction systems and to ascertain the effects of any such condensation on the biological activity of the two auxins.

Colored complexes that showed a new absorption peak at approximately 510 mμ were formed between the polyphenol oxidase generated quinones of catechol and chlorogenic acid and IAA. The reaction was favored at an acidic pH. Chromatography of reaction systems using β-C^{14} IAA showed significant amounts of radioactivity condensed in melanins left on the starting line. Two new radioactive spots were also present in the IAA-chlorogenic-polyphenol oxidase reaction system.

A purple complex absorbing at 510 mμ was formed between HIAA and catechol whereas a yellow-green complex absorbing at 420 mμ was formed with the former and chlorogenic acid. The reaction was faster at a neutral or slightly alkaline pH.

Evidence is presented to show that in a 1-1 reaction mixture of phenol-auxin there is a complete reaction between HIAA and o-quinones and an approximately 50 per cent reaction between IAA and o-quinones.

The biological activities of the auxin-phenol complexes were studied using the Avena coleoptile straight growth test. The growth stimulatory activity of HIAA to Avena coleoptiles was completely lost upon its incorporation into phenol complexes, using the o-quinones of either catechol or chlorogenic acid. In contrast, the growth stimulatory activity of IAA is not destroyed by its incorporation into phenol complexes. At high concentrations the complex is non-inhibitory to Avena coleoptile sections. At low concentrations, the complex is just as active as free IAA. The IAA-catechol complex is stable to ether extraction from a pH 5.0 buffered solution.

Microfilm $2.75; Xerox $5.00. 98 pages.

THE EFFECT OF PHOSPHORUS AND POTASSIUM ON THE BOTANICAL AND CHEMICAL COMPOSITION, YIELD, AND PERSISTENCE OF ALFALFA AND CERTAIN GRASSES GROWN IN COMBINATION.

(Order No. Mic 61-2711)

Joseph Neal Pratt, Ph.D.
Michigan State University, 1961

Major Professor: H. D. Foth

The effect of phosphorus and potassium on the botanical and chemical composition, yield, and persistence of alfalfa when grown in association with certain grasses was studied under field and greenhouse conditions. Field plots established in 1954 were used to study the persistence of unfertilized alfalfa.

The botanical composition, yield, and chemical composition of forage for the fourth harvest year, 1958, were determined. Five soil profiles were sampled and analyzed for reserve phosphorus and potassium by horizons.

Fertilizer subtreatments resulted in yield differences which were highly significant for all eight cuttings over a four year period from 1954 to 1958. The highest amount of alfalfa in the forage occurred in the treatment and subtreatment receiving no fertilization at the time of establishment or as a topdressing. A significant negative correlation existed between the percentage of alfalfa in the forage and the amount of phosphorus in the soil. Increased phosphate applications increased the amount of phosphorus extracted from soil samples, but increased potash applications resulted in little influence on the amounts of potassium extracted from soil samples.

In the 1959 field experiment, significant differences in yield existed as a result of five fertilizer treatments applied in the fall of 1958. Only treatments receiving the potash yielded significantly higher amounts of forage than the original check plots established in 1954 and which were check plots in 1959.

A tendency for decreased yield with phosphorus fertilization and increased yield with potash fertilization was shown by alfalfa with a reverse tendency shown by bromegrass. No radical change in the percentage of alfalfa in

the forage during one growing season was noticed as a result of fertilizer treatment.

Phosphate fertilization increased the phosphorus content while decreasing the potassium content of both alfalfa and bromegrass tissue.

Potash fertilization increased the yields of both alfalfa and bromegrass. It caused little to no change in the phosphorus content while increasing the potassium content of both alfalfa and bromegrass.

Removal of soil phosphorus was increased as a result of both phosphate and potash fertilization. Removal of soil potassium was increased by potash fertilization and unchanged by phosphate fertilization.

In all three greenhouse experiments, striking similarities of yield resulted from phosphate and potash fertilization. High levels of phosphate fertilization increased the yields of grasses and had little influence on the yields of alfalfa. High levels of potash fertilization resulted in higher yields of alfalfa and lower yields of grasses.

The botanical composition of the alfalfa-bromegrass association showed significant differences as a result of both phosphate and potash fertilization. The lowest amount of applied phosphate produced the highest percentage of alfalfa in the forage, with the highest amount of phosphate producing the lowest percentage of alfalfa in the forage. Potash fertilization increased the percentage of alfalfa at low levels of added phosphate, but not at high levels of added phosphate.

The percentage of phosphorus and potassium in the tissue of alfalfa and the associated grass was increased as the applications of these nutrients were increased.

In all three greenhouse experiments, alfalfa contained a higher percentage of phosphorus in the tissue than the grass grown in association. The phosphorus content of bromegrass was higher than the phosphorus content of timothy and ryegrass.

Negative associations were found in all three greenhouse experiments between the percentage of alfalfa in the forage and the phosphorus content of the soil.

The persistence of alfalfa when grown with an associated grass without phosphorus or potassium fertilization was attributed to the subsoil furnishing phosphorus in sufficient amount to enable alfalfa to compete with a shallow rooted grass plant. The restricted growth of grass, in turn, enabled the soil to supply sufficient potassium to maintain the alfalfa in association with a grass. The pH of the surface and subsurface horizons may have proved a disadvantage in phosphorus uptake by the grass.

Microfilm $2.75; Xerox $4.80. 95 pages.

A STUDY OF THE EFFECT OF GROWTH SUBSTANCES ON FRUIT-SETTING OF THE MANGO

(Order No. Mic 61-2246)

Thomas Tracy Sturrock, Ph.D.
The University of Florida, 1961

Certain commercial varieties of mango (Mangifera indica L.) are poor bearers. The light bearing varieties are usually of a monoembryonic type while the heavy bearing varieties are usually of a polyembryonic type.

An attempt was made in this investigation to determine some of the causes of poor fruit-set of the monoembryonic varieties of mango. To accomplish this several approaches to the problem were used. First, the influence of growth substances on fruit-set was determined. A wide spectrum of materials was included in this group of substances. Second, cytological observations were undertaken to compare the morphological sequence of events leading to development of fruits of mono- and polyembryonic varieties of mango. Third, a comparison was made of the growth substances found in the young fruits of these two types of mango. Fourth, growth factors and nutrients were supplied to the mango blossom panicles in an attempt to increase fruit-set. Fifth, blossom panicles were pruned in various ways to determine if competition among the many blossoms might be a factor in reducing fruit-set.

In the spray tests there was a very highly significant difference among the chemicals in their initial effect on mango fruit-set, but this effect was transitory and at maturity there was no difference among the various treatments.

No evidence was shown by cytological observations that fertilization had occurred when the fruit started to develop. However, fruit enlargement was associated with endosperm formation. In the polyembryonic variety tested (Earle), the endosperm was found to be diploid (2n = 40). While an exact count was not obtained in the monoembryonic variety tested (Edward), the chromosome number in the endosperm appeared to be more than diploid and approached the expected triploid (3n = 60) condition.

The biochemical analyses of young fruit showed the presence of more growth promotors in the polyembryonic than in the monoembryonic extracts. The monoembryonic extracts had more growth inhibitors than the polyembryonic extracts.

In the tip-feeding tests there was also an early difference in favor of some of the treatments which disappeared toward maturity. No apparent advantage was shown by panicle pruning.

It is suggested by the results of these studies that: (1) the polyembryonic variety was able to set fruit without fertilization because of the development of apomictic endosperms and nucellar embryos; and (2) the monoembryonic variety must have fertilization in order to set fruit.

Microfilm $2.75; Xerox $5.00. 97 pages.

MORPHOLOGICAL AND DEVELOPMENTAL CHANGES IN THE BEAN PHASEOLUS VULGARIS L. AS MODIFIED BY THE APPLICATION OF VARIOUS GROWTH REGULATORS

(Order No. Mic 61-1674)

Joseph S Vandemark, Ph.D.
University of Illinois, 1961

The common bean, Phaseolus Vulgaris was treated with various growth regulators in an effort to change its growth habit, to increase yields and enhance uniformity of maturity.

Data were collected on plants grown both in field and greenhouse. Fruiting habits and physiological, chemical

and morphological modification resulting from treatments of maleic hydrazide (MH), synthetic growth substances and their combinations were noted. All plants were treated when the primary leaves were expanding.

Application of MH caused a marked delay in maturity and lateral branches to develop at the first and second nodes, and apical inhibition was proportional to the quantity applied. The effect of MH was most markedly expressed on subsequent growth of the plant when application was made while the primary leaves were rapidly expanding.

Synthetic growth substances (IAA, NAA, and 2,4-D) applied in low physiological concentrations all enhanced yields significantly but resulted in less apparent morphological modifications than MH. There were additive and antagonistic effects if MH and 2,4-D were applied to the same plant. There was increased nitrogen content and a larger number of fruits on branches from higher nodes as well as a reduction of apical inhibition. The combination resulted in a reduction of plant abnormalities as caused by 2,4-D alone.

Gibberellic acid resulted in elongation of internodes, earlier flowering and reduced yields when used alone or in combination with MH.

The most desirable treatment seems to be a combination of 100 ppm MH plus 1 ppm 2,4-D. The concentration may be doubled if the ratio remains constant. If the treatment is applied within the first week of emergence with sufficient volume to cause runoff, the plants will have more uniform yields, increased lateral branching at the first and second nodes and will mature without appreciable delay or morphological abnormalities.

Microfilm $2.75; Xerox $4.00. 73 pages.

AGRICULTURE, PLANT PATHOLOGY

SEED AND POLLEN TRANSMISSION OF CHERRY RING SPOT VIRUS IN BUTTERCUP SQUASH

(Order No. Mic 61-2420)

Chittaranjan Das, Ph.D.
Oregon State College, 1961

Major Professor: J. A. Milbrath

Cherry ring spot virus has been reported by various workers to be transmitted by seeds from several stone fruit hosts. There have not been any previous reports of seed transmission in the various herbaceous hosts of this virus. Pollen transmission of the virus to seeds but not to the parent plant has also been reported.

Buttercup squash plants can be easily infected by mechanical inoculation with cherry ring spot virus. Very characteristic and diagnostic symptoms develop readily on infected plants. The monoecious nature of the flower, the development of large numbers of ovules in a fruit, and the ease of growing a large number of plants in a short period of time makes this plant an ideal host that can be used to obtain more information on the nature of seed and pollen transmission of cherry ring spot virus.

A preliminary experiment on seed transmission of the virus in Buttercup squash plants showed that 2.58 percent of the seed were infected. These seeds were collected from fruits harvested from naturally pollinated plants in a diseased plot. When seeds from the same plot were stored for 18 months at 35°F., only 0.49 percent transmitted the virus.

In a subsequent field experiment on seed transmission with Buttercup squash plants only 0.59 percent transmission occurred when flowers on cherry ring spot virus infected plants were pollinated with pollen from healthy plants, and only 0.44 percent when flowers on infected plants were pollinated with pollen from infected plants. No seed transmission was observed in 5974 seeds that resulted from fertilization of healthy ovaries with diseased pollen.

The percentage of flat, empty or undeveloped seeds produced varied with different combinations of healthy or diseased ovaries pollinated with healthy or diseased pollen. The highest percentage, 19.76, resulted from placing diseased pollen on ovaries of diseased plants.

When healthy plants were pollinated with infected pollen by a pollen gun, to prevent any other contact with infected host tissue, 9 out of 97 plants showed typical cherry ring spot virus symptoms at the growing tips under greenhouse conditions. There was an increase in the number of plant infections with an increase in the number of flowers pollinated on an individual plant. When a single flower on each plant was pollinated, 4.0 percent of the plants became infected. Infection increased with number of pollinations up to 14.28 percent when four flowers on each plant were pollinated.

Some of the fruits, which developed from pollination of healthy ovaries with diseased pollen under the above experiment, were tested for the presence of virus. The fleshy portion and immature seeds from such fruits were tested by macerating them and inoculating on young squash plants. The presence of virus was detected in both the fleshy portion and in immature seeds from the fruits collected from plants that became infected. No virus was recovered from fruits collected from pollinated plants which did not show any virus symptoms on the leaves.

Mechanical transmission of virus from pollen from flowers developed on diseased plants was tested by grinding the pollen and inoculating on young Buttercup squash plants. Pollen developed in flowers on diseased plants was shown to carry virus.

Evidence was obtained which indicated that seed transmission of cherry ring spot virus in Buttercup squash plants takes place only when the ovule is infected prior to fertilization. Although a high percentage of the plants became infected by pollen from diseased plants, none of the seeds produced by such fertilization carried the virus.

When ovules on infected plants were fertilized with normal pollen, seed transmission did occur.

Microfilm $2.75; Xerox $3.00. 58 pages.

SOME PHYSIOLOGICAL COMPARISONS OF THE FUSARIUM SURFACE ROT AND FUSARIUM WILT PATHOGENS OF SWEET POTATO

(Order No. Mic 61-2296)

Kenneth Deane Fisher, Ph.D.
North Carolina State College, 1960

Supervisor: Lowell Wendell Nielsen

The pathological capabilities and several physiological properties of the sweet potato pathogens that cause surface rot and Fusarium wilt were compared. Pathogenicity tests confirmed that surface rot of sweet potato is caused by Fusarium oxysporum Schlect. The pathogen does not induce symptoms of fusarial wilt, and conversely, the wilt pathogen, F. oxysporum f. batatas, does not cause surface rot. The surface rot fungus is morphologically similar to the wilt fungus.

Isolates of the two pathogens have similar requirements for growth in culture. Cardinal growth temperatures of the surface rot and wilt isolates were 8.0°, 27.5°, and 35.0°C. At temperatures between optimum and maximum, the growth of surface rot isolates on solid and liquid media exceeded that of wilt isolates. Although no differences in qualitative utilization of several carbon sources were established, quantitative differences in utilization of xylose, glucose, pectin, and carboxymethylcellulose were noted. These differences were more pronounced when isolates were grown on a restricted nutritional medium and these differences were confounded by temperature.

Culture filtrates of surface rot and wilt Fusaria grown in identical cultural conditions contained similar amounts of the pectinolytic enzymes polygalacturonase, depolymerase and pectinmethylesterase and a cellulolytic enzyme (Cx).

The surface rot isolates were physiologically distinguishable from wilt isolates in several respects. Both pathogens produced a brown discoloration of malt-extract-agar medium amended with gallic or tannic acid (Bavendamm reaction). However, the extent and intensity of this oxidation reaction was more pronounced in those solid or liquid media seeded with surface rot isolates than in those seeded with the wilt isolates. Results of this and other tests indicated that the two pathogens possessed different levels of extracellular oxidative activity. While peroxidase activity was present in mycelia of both surface rot and wilt Fusaria, production of extracellular laccase, polyphenol oxidase (as catecholase) or chlorogenic acid oxidase by either pathogen was not detected. However, each of the four isolates was able to grow when ferulic, vanillic, syringic, or p-hydroxyphenolpyruvic acids, or catechol were supplied as the carbon source.

The pathogens also differed in their production of fusaric acid. Surface rot isolates did not produce fusaric acid on modified Richard's solution prepared with several carbon sources. Wilt isolates produced fusaric acid when xylose or glucose was the carbon source, but not when pectin or carboxymethylcellulose was the carbon source. When vine cuttings were inoculated with wilt isolates grown on pectin or carboxymethylcellulose, symptoms of wilt were regularly observed.

Culture filtrates of surface rot isolates produced little vascular browning in wilt susceptible sweet potato vine cuttings. Culture filtrates of wilt isolates, culture filtrates of surface rot organisms containing 10^{-3} M fusaric acid and solutions of fusaric acid produced extensive vascular browning in addition to arresting adventitious root development and leaf expansion. While boiling destroyed the ability of culture filtrates of the wilt isolates to induce these symptoms, boiling had little effect on the effectiveness of culture filtrates containing fusaric acid. It is suggested that the wilt syndrome in sweet potato involves several factors other than production of hydrolytic enzymes and specific metabolites such as fusaric acid.

Microfilm $2.75; Xerox $4.60. 87 pages.

THE REACTION OF SEVERAL VARIETIES OF SWEET POTATOES TO FIVE SPECIES OF ROOT-KNOT NEMATODES (MELOIDOGYNE SPP.)

(Order No. Mic 60-5909)

Mike John Giamalva, Ph.D.
Louisiana State University, 1960

Supervisors: Professors T. P. Hernandez and W. J. Martin

Root-knot nematodes, especially Meloidogyne incognita acrita, are widely distributed in some sweet potato producing areas. They are most commonly found in sandy soils. The commercial field control of root-knot nematodes is very costly and in many cases is impractical. Root-knot nematodes are parasitic on some sweet potato varieties. Until recent years, little was known of the differences in susceptibility to different species of root-knot nematodes. Also, root cracking has been associated with nematode infestations.

The object of this study was to determine the reaction of sweet potato varieties to five species of root-knot nematodes which are found in the growing areas of the United States, and to determine the pathogenicity of root-knot nematodes collected from sweet potato fields throughout Louisiana. Tests were also conducted to study the effect of nematodes in the development of Fusarium wilt in sweet potatoes.

The reaction of eight sweet potato varieties to five species of root-knot nematodes was studied in a greenhouse test. The varieties used were Porto Rico, Goldrush, Acadian, Heartogold, Allgold, Nemagold, Ll-80 and Centennial, and the nematodes used were, Meloidogyne arenaria, M. hapla, M. incognita, M. incognita acrita and M. javanica.

Heartogold and Nemagold were resistant to all species of nematodes tested. M. incognita caused a very light infection on Heartogold.

Allgold was very susceptible to M. incognita, M. incognita acrita and M. javanica. This is the first report of M. javanica infecting the sweet potato. Goldrush, Acadian and Ll-80 were very susceptible to M. incognita and to M. incognita acrita. Porto Rico and Centennial were intermediate in their reaction to M. incognita. M. hapla produced very light to light galling on all varieties except Heartogold and Goldrush.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

M. arenaria produced no galling on any of the varieties; however, it caused very slight to moderate root necrosis. Neither root necrosis nor root weight could be used as an absolute measure of susceptibility, but should be considered.

Number of larvae in the soil were positively correlated with root gall ratings. This indicates that those varieties with a high root gall rating are good hosts to these species. Root galling alone is a good measure of susceptibility of sweet potatoes to root-knot nematodes.

An isolate of M. incognita was found to cause moderate galling on Heartogold, indicating that there are races within this species that vary in their pathogenicity to this variety.

From one year's results of a test using Nemagon soil fumigant, no conclusions could be drawn except that there were differences among varieties in per cent cracked roots and number of nematodes in the roots.

The reaction of four sweet potato varieties to 16 isolates of root-knot nematodes were studied in a greenhouse test. The varieties used were Goldrush, Acadian, Porto Rico and Heartogold. These isolates were all identified as M. incognita acrita. Goldrush and Acadian were susceptible to all isolates, Porto Rico intermediate and Heartogold resistant. Relatively few, small root galls were produced on the Heartogold variety by all isolates except one. The original M. incognita acrita culture used in the other greenhouse tests produced no galling. This indicated that there are races within M. incognita acrita that vary in their pathogenicity to this variety.

To determine the possible role of nematodes in enhancing development of Fusarium wilt in sweet potato, tests were conducted using Fusarium alone and Fusarium plus each species of root-knot nematode on two sweet potato varieties. The differences in wilt indices were due to differences in wilt resistance of the varieties. Root-knot nematodes had no effect on the incidence of Fusarium wilt.

Microfilm $2.75; Xerox $3.80. 67 pages.

COMPARATIVE MORPHOLOGY AND RESPIRATION OF NORMAL AND DISEASED HELMINTHOSPORIUM VICTORIAE

(Order No. Mic 61-2127)

Evangelos Eleftheriou Psarros, Ph.D.
Louisiana State University, 1961

Supervisor: Professor G. D. Lindberg

A comparative morphological cytological study of normal and diseased cultures of Helminthosporium victoriae revealed certain irregularities that characterized the diseased colonies. Young hyphae from newly diseased colonies showed various degrees of lytic degeneration and attempts to detect nuclei in such hyphae were unsuccessful. Similar to normal H. victoriae, young hyphae from diseased colonies obtained by subculturing from severely diseased mycelium did not show any signs of lytic degeneration and contained abundant nuclei. These hyphae did, however, show various kinds of distortions in the morphology of cells and in the pattern of growth.

In comparative respiratory studies, diseased H. victoriae from 10-day old stationary and from 2- to 6-day old shake-cultures showed an increased respiratory rate compared with that of the normal fungus. In addition, diseased H. victoriae from 4-day old shake-cultures did not show any increase in respiratory rate in the presence of low concentrations of DNP (5×10^{-5} and 1×10^{-4} M), whereas the normal fungus showed a positive response.

Comparative study of the process of infection of susceptible oat seedlings with normal and diseased H. victoriae revealed little differences. However, the degeneration of tissue inoculated with the diseased fungus was slower and less extensive than that inoculated with the normal fungus.

Microfilm $2.75; Xerox $4.00. 72 pages.

INVESTIGATION OF THE RELATIONSHIPS OF PLANT-PARASITIC NEMATODES TO THE STUNTING OF PINES IN OUTPLANTINGS

(Order No. Mic 61-2305)

John Leonard Ruehle, Ph.D.
North Carolina State College, 1961

Supervisor: Joseph Neal Sasser

Several plant-parasitic nematode species were found to be associated with stunted loblolly and slash pine in plantations. The most predominant species were lance, Hoplolaimus tylenchiformis; pine cystoid, Meloidodera floridensis; spiral, Helicotylenchus nannus; and American dagger, Xiphinema americanum. In general, higher populations of lance and pine cystoid were isolated from soil samples taken from sites exhibiting poor growth than from sites exhibiting good growth.

Pine nurseries were also found to be infested with lance and spiral nematodes as well as stunt, Tylenchorhynchus claytoni and stubby root, Trichodorus christiei. Those forms indigenous to the outplanting sites, however, were shown to be more important in the stunting of pines than those transported from the nursery in or on planting stock.

The four predominant species found in the survey of plantations, lance, pine cystoid, spiral and American dagger, were found to feed and reproduce on slash and loblolly pine. Other species found less frequently, Belonolaimus gracilis, Tylenchorhynchus claytoni and Meloidogyne arenaria also fed and reproduced on these two pine species.

In pathogenicity tests, lance nematodes were found to be more destructive than pine cystoid, spiral or dagger, as evidenced by height growth and root damage. Pine cystoid caused considerable root damage but did not impair growth as markedly as lance. Spiral and American dagger nematodes had little or no effect on growth of slash and loblolly pine.

Lance nematodes penetrated and fed endoparasitically on both lateral and mycorrhizal short roots. By feeding on and migrating through the cortex they caused extensive internal damage. In several cases these nematodes were found lying in the cortex with their head curved in toward the vascular tissue. Pine cystoid larvae entered both lateral and mycorrhizal short roots. Mature females were found lying in the cortex, in some cases bursting the outer

layer of tissue. Giant cells surrounded by hyperplastic tissue developed in the region adjacent to the head of the maturing females. Maturation and enlargement of the female nematodes caused, in certain instances, a compression and collapse of the surrounding tissue.

Fumigants applied in rows at nematocidal rates in field fumigation tests prior to planting caused an increase in the initial survival and growth of slash and longleaf pine. The growth of both species was best in rows fumigated with D-D (dichloropropene-dichloropropane) at the rate of 20 gal. per acre.

These investigations have shown the association of plant pathogenic nematodes with poor survival and stunting of pines in outplanting sites. Greenhouse studies further demonstrated the destructive effects certain of these pathogens have on the roots of both slash and loblolly pine. Fumigation at nematocidal rates indicated that control of the nematodes increased survival and growth of seedlings. In the plantation however, other factors such as soil type, fertility, seasonal fluctuations in moisture and temperature, and various pathogens associated with nematodes appear to be contributing to the poor survival and stunting of pines. Microfilm $2.75; Xerox $5.20. 105 pages.

BLUEBERRY STEM BLIGHT CAUSED BY BOTRYOSPHAERIA DOTHIDEA

(Order No. Mic 61-2293)

Wesley Witcher, Ph.D.
North Carolina State College, 1960

Supervisor: Carlyle Newton Clayton

Stem blight caused by Botryosphaeria dothidea (Fr. ex Ces. & de Not.) von Arx and Muller is one of the limiting factors in blueberry production in North Carolina. A characteristic symptom of stem blight is a yellowing or drying of leaves on one or more dying branches of a plant.

This study was made to determine the occurrence and severity of the blueberry stem blight in North Carolina, the correct taxonomic position of the fungus which causes it and factors affecting inoculation and infection. Stem blight was present in 37 of 39 blueberry fields surveyed in 1959. The percentage of plants affected in the different fields varied from zero to 42 with an average of nine.

The causal fungus had been reported to be an undescribed species of Botryosphaeria. Although it was very similar to the fungus formerly known as Botryosphaeria ribis Gross. & Dugg., the stem blight fungus varied from it in the following respects: 1) the ascospores were slightly wider than those of B. ribis; 2) the conidia became dark and septate during germination; 3) the perfect stage occurred occasionally in culture; and 4) when grown on PDA it caused a yellow color to form in the medium.

In this study the stem blight fungus presently known as B. dothidea, was compared to the fungus formerly known as B. ribis and the two were found to be identical. The sizes of spores of isolates from various hosts overlapped and some conidia of isolates from all hosts became septate prior to germination. Perithecia of isolates of the stem blight fungus and B. dothidea were produced sparsely in culture. Some isolates of B. dothidea from apple caused a yellow color to form in PDA and some of the isolates of the stem blight fungus did not. The purple and yellow chromogenesis formed by certain isolates in Czapek's solution at certain pH levels was not correlated with pathogenicity. The variable isolates from several host plants were found to be of one species. In their 1954 reclassification of the Pyrenomycetes von Arx and Muller placed B. ribis as a synonym of B. dothidea.

In pathogenicity tests all isolates of B. dothidea from seven hosts including apple, allspice, blueberry, grape, lilac, tung and tupelo gum, were found to be pathogenic on apple fruits and on blueberry stems. Three isolates were inoculated to blueberry fruits and found to be pathogenic on them. Although there appeared to be some differences in virulence between isolates, plants of 16 blueberry varieties on inoculation were susceptible to stem blight.

Stem blight appeared in some cases to be correlated with poorly drained soil whereas in other cases it was not. On the basis of the survey of 39 blueberry fields in 1959 stem blight appeared to be correlated with plant parasitic nematodes in the soil. Blueberry plants in two fields were found to be heavily infested with the root-knot nematode, Meloidogyne incognita. Nematodes of one or more of five genera, Dolichodorus, Helicotylenchus, Hemicycliophora, Scutellonema and Trichodorus were found in 36 fields. Nematodes of these genera multiplied in sterile soil in which Wolcott blueberry plants were growing.

Another blueberry stem disease called twig blight has symptoms easily confused with stem blight. Twig blight, caused by the fungus Diaporthe vaccinii Shear, was found in North Carolina on less than one per cent of the plants surveyed in 1959.

Microfilm $2.75; Xerox $4.80. 95 pages.

THE EFFECT OF CHEMICALLY-DEFINED MEDIA UPON TISSUE CULTURES OF SKIN, CYSTIC DISEASE AND CARCINOMAS FROM THE HUMAN FEMALE BREAST

(Order No. Mic 61-2320)

Mary Faith Orr, Ph.D.
Vanderbilt University, 1961

Supervisor: Dr. James W. Ward

Specimens of skin, cystic disease, carcinomas, twelve-day chick heart and leg muscle have been cultivated by the roller-slide method. All the tissues produced good outgrowths in the standard nutrient composed of 70% Hanks' balanced salt solution, 27% ascitic fluid and 3% embryo extract. Skin cultures produced sheets of epithelium. Cystic disease and carcinoma tissues produced both fibroblasts and epithelial outgrowths.

Chemically-defined media 199, 857, 1066, 109 and Eagle's basal medium were tested on cultures of these tissues by incorporating them in the nutrient fluid at a concentration of 70%. Eagle's basal medium and 199 gave good outgrowths from all of the tissues. Medium 199 produced outgrowths of skin that were more dense and extensive than those produced in the standard or Eagle's basal medium. Medium 857 gave the poorest outgrowths from skin, cystic disease and embryonic tissues. Medium 109 allowed beginning outgrowths of skin, and a scant fibroblastic outgrowth from cystic disease. There were more frequent and extensive beginning outgrowths from skin in 1066. Skin outgrowths in both 109 and 1066 had begun to degenerate by the eighth day of cultivation, but the degeneration in 1066 was not as marked as in 109. Sporadic outgrowth from cystic disease in 1066 equaled that in the standard. Carcinomas responded to all of the nutrients as in the standard.

Histologic sections were made of explants of cultures of skin, cystic disease and carcinomas. Sections of skin in the standard nutrient, medium 199 and Eagle's basal medium showed increase keratinization and migrating Malpighii cells which formed the outgrowth. In media 857, 109 and 1066 the epidermis showed keratinization and degeneration down to the dermis.

Cystic disease explants were very similar in the standard nutrient, 199, 109 and 1066. The organization of the tissue was maintained. There was increased fibroblastic activity in the connective tissue. The epithelium was similar to the tissue before cultivation. Medium 857 produced marked necrosis of both epithelial and connective tissue elements. Eagle's basal medium preserved the tissues and cells better than any other nutrient.

There was a marked loss of epithelium in carcinoma explants in all the nutrients. The connective tissue developed large pale staining amorphous areas. Eagle's basal medium preserved the epithelium better than any other nutrient in areas where there was organization.

Media 857, 109 and 1066 contained coenzymes. The concentration (10 mg%) in 857 and in 1066 (2 mg%) were added to the standard nutrient, 199 and Eagle's basal medium and tested on all the tissues. Ten mg% did not inhibit growth, damage the cells or grossly stimulate outgrowths. Carcinomas responded to both concentrations as in all the other nutrients.

Medium 199 produced outgrowths from skin that were better than those in any other nutrient. This medium contained purines and pyrimidines that were not present in any other media indicating that these substances were nutritionally beneficial to these cells.

Inhibition of outgrowths from skin, cystic disease and chick tissues was greater in 857, 109 and 1066 than in the standard, 199 and Eagle's basal medium plus 10 mg% coenzyme concentrate. This suggests that the deoxyribonucleosides present in 857, 109 and 1066 may be toxic to these tissues.

Microfilm $2.75; Xerox $5.00. 99 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

PROTESTANT MISSIONARIES TO THE AMERICAN INDIANS, 1787 TO 1862.

(Order No. Mic 61-2441)

Robert Frederick Berkhofer, Jr., Ph.D.
Cornell University, 1960

This thesis is an essay in ethnohistory, which attempts to unite the anthropologist's concern with process and the historian's disciplined approach to documentary data about the past. Because of this particular combination of disciplines, ethnohistory can make a valuable contribution to those acculturation studies in which a subordinate culture is modified by intercourse with a dominant civilization, which kept records of the contact. The efforts of Protestant missionaries to convert the American Indians offer an excellent opportunity to apply this approach. For the purposes of this study, the writer researched the sequence of events from missionary arrival in a tribe to the failure or disruption of a mission or, if it was successful, to 1862. Sequences involving different denominations and various tribes were then compared to discover whether any uniformities existed in the missionization process. The organization of the thesis reflects these conclusions.

Part One, "The Missionaries' World," examines the missionaries' explicit goals and their activities as well as their culture setting and the conditions of contact specified by the dominant civilization. Since the missionaries, regardless of denomination, were convinced adherents of their own culture, they could not help but spread secular civilization along with Christianity in their efforts to achieve the professed goal of propagating the gospel. For this reason and because of their assumptions regarding "human nature," each mission station was a model of school, church, home and farm in order to demonstrate learning, piety, and agriculture. As long as government agents and other whites among the Indians favored, or even aided, these goals, the missionaries considered them good men; otherwise they were agents of Satan.

Part Two, "Indian Societies in Transition," analyzes aboriginal reactions to missionization and their place in the larger framework of culture contact. As civilization and religion were inextricably combined in the blackcoats' eyes, so the Indians, regardless of tribe, reacted to the program as a whole -- except in the more acculturaled tribes. If the missionary wasn't forcibly ejected after a brief distribution of the loaves and fishes, then he slowly gained adherents. As his converts increased, tribal reaction changed from persecution of individuals to antagonism between groups – or factions – within the village or tribe. After factionalism had developed, the Christian and Pagan Parties either physically separated or evolved a society that was socially integrated by a new form of government but not culturally integrated as of old. These reactions occurred within and depended upon the larger framework of White-Indian relations especially as determined by federal policy of annuity and army. Because the missionary in the period under study was a major representative of the dominant American civilization in the contact situation, the theoretical sequences based on the missionization process may well serve as a model for general acculturation studies involving the American Indian.

An appendix has been included to familiarize the reader with the missionary societies and their fields of endeavor in the three-quarters of a century between the Revolution and the Civil War.

To the missionary mind of the period the experiment to civilize and Christianize the American Indians was bound to be interpreted as a failure. The criteria for judging the experiment's success were part of the basic value system of the culture in which the judges lived. Yet the very social assumptions that determined the goals hindered their realization, for these assumptions failed to correspond with the cultural reality of the contact situation.

Microfilm $6.90; Xerox $24.55. 544 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

ASTRONOMY

PROFILE OF THE H-GAMMA LINE IN THE WHITE DWARF 40 ERIDANI B

(Order No. Mic 61-2121)

Jerry Don Fuller, Ph.D.
Louisiana State University, 1961

Supervisor: Dr. Raymond T. Grenchik

The ultimate test of a model stellar atmosphere is the comparison of resulting theoretical line profiles with the observed spectrum.

Line profiles of the Balmer H-gamma line have been calculated for two model atmospheres, one of pure hydrogen, the other with equal numbers of hydrogen and helium atoms. In both cases the broadening of the absorption line was assumed to result solely from the first order Stark effect in hydrogen, with both hydrogen ions and plasma electrons being included as perturbers.

The extremely involved computations, especially of the line absorption coefficients, were programmed and performed on an IBM 650 digital computer. Even so, the calculation of a single line profile requires approximately twenty-four hours of machine time,

The theoretical profiles obtained are found to be broader and deeper than the observed one, though in the far wings and near the center the agreement is fairly good. The profile obtained from the atmosphere containing helium is slightly broader and deeper than the pure hydrogen profile, in agreement with earlier predictions.

Microfilm $2.75; Xerox $3.60. 64 pages.

BACTERIOLOGY

COMMENSAL BACTERIA OF MARINE ANIMALS — A STUDY OF THEIR DISTRIBUTION, PHYSIOLOGY AND TAXONOMY.

(Order No. Mic 61-2096)

Rita Barbara Rossi Colwell, Ph.D.
University of Washington, 1961

Chairman: Dr. John Liston

An investigation was carried out on the bacteria commonly associated with marine animals, both vertebrate and invertebrate, including twenty-five species of fish, representing twenty genera and nine species of invertebrates. Samples were taken from invertebrates of the phyla Porifera, Coelenterata, Mollusca, Arthropoda and Platyhelminthes. Bacterial cultures were collected from animals of the classes Chondrichthyes and Osteichthyes of the phylum Chordata.

A total of 736 pure cultures of bacteria were obtained, which were tested over a schedule covering morphological, physiological, nutritional and biochemical characteristics. The generic distribution of the total sample was: Pseudomonas, 44.0 percent; Gut Group Vibrio, 6.7 percent; Achromobacter, 15.6 percent; Flavobacterium, 9.0 percent; Corynebacterium, 3.5 percent; Bacillus, 3.9 percent; Micrococcus, 7.8 percent; non-fecal Enterobacteria, 3.4 percent; and other types, 6.1 percent. Bacteria such as Alcaligenes, Brevibacterium, Arthrobacter, Photobacterium and yeasts were grouped as "other."

The biochemical and physiological characteristics of these bacteria showed that roughly fifty percent were proteolytic and that saccharolysis was predominantly via the aerobic pathway. A very low incidence of lactose fermenters was noted. These results, in conjunction with the results of other tests, such as the urease, nitrate reduction, indol production, citrate utilization, gluconate oxidation, etc., suggest that a consistent portion of the population of bacteria which live in association with marine animals maintain the ability to derive nutrition by a variety of reactions.

A comparison of the commensal floras of vertebrate and invertebrate animals showed that the distribution of bacterial types did not differ greatly. However, invertebrate animals tended to yield samples with slightly greater numbers of Flavobacterium, Bacillus and Micrococcus, probably attributable to greater proximity of the invertebrates tested to terrestrial contamination.

The effect of temperature of isolation (OC and 25C) was found not to be significant. The over-all distribution of bacterial types within samples taken from marine animals was roughly the same at the two temperatures of incubation, but the 25C temperature for isolation was concluded to be preferable since the less numerous types, i.e., the fastidious and the mesophilic organisms, are represented as a part of the total normal flora.

Samples obtained from fish collected by several methods of capture; i.e., hand line, otter trawl, inshore otter trawl, beach seine and purse seine, were compared. In general, the line-caught fish yielded a flora which can be considered most like that on fish in the natural state.

Some differences were noted in the distribution of bacterial types within the flora of fish caught in widely

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different geographical areas. South Pacific (Eniwetok and Rongelap Atolls) fish yielded slightly higher numbers of Gram-positive and fermentative types of bacteria than did fish obtained in the North Pacific (Washington Coast and Puget Sound). Cultures from Puget Sound animals were predominantly psychrophilic, those of the South Pacific, mesophilic. A residual eurythermic (circa 25 percent) proportion of the bacterial populations from fish caught in both areas of the Pacific was noted.

A commensal flora of the skin, gut, gills and mouth of vertebrates and the body fluid and digestive tract of invertebrates was described.

The postulate that phylogenetic differences among the marine animals themselves can effect peculiarly specific commensal floras for vertebrates and invertebrates, for teleosts and elasmobranchs within the Class Pisces and for the different phyla of invertebrates, was not confirmed by the results of this investigation.

The problems of the classification and taxonomy of the Pseudomonas/Achromobacter group, predominant in the commensal flora of marine animals, were investigated. A program for the IBM 650 electronic computer was written to handle the large volume of taxonomic data.

A control study of forty well-characterized, mainly type culture collection strains was made. From the results, a clear separation of the major bacterial groups, the families Pseudomonadaceae, Enterobacteriaceae, Micrococcaceae, Corynebacteriaceae and Bacillaceae, was obtained, indicating the validity of the computer method. An assignment of numerical values of percent similarity for levels of taxonomic relationship could be made from these results. Thus, the species level of similarity could be $\geqslant 70$ percent and the generic, or possibly the family, level of similarity approximately $\geqslant 60$ percent.

The computer method was applied to eighty pseudomonads, twenty of which were American Type Culture Collection strains and the remainder fresh isolates from marine sources. No apparent clustering of freshly isolated strains around the defined American Type Culture strains was noted, but "species groups" did form and were amenable to further analysis.

Four groupings of organisms were determined, a "marine group" of organisms whose growth was enhanced by sea water, a Vibrio percolans-Pseudomonas fragi group intermediate in biochemical activity between the rather inactive marine group and the third group, the fluorescent, generally pigment-producing group, Group 3.

Group 3 was divisible into three subgroups: a psychrophilic Pseudomonas aeruginosa subgroup; a mesophilic P. aeruginosa subgroup; and finally, a heterogeneous Vibrio cuneatus-Pseudomonas fluorescens subgroup.

The fourth grouping was a principally mesophilic, nitrate-reducing, gelatin-liquefying group producing alkaline conditions in litmus milk.

The detailed characteristics for each of these groups and subgroups are given in the text.

Applying the groupings obtained from the computer method to freshly isolated strains of marine organisms, a general relationship of cultural characteristics with groups isolated from marine fish by other workers was shown. Thus, most of the asporogenous, Gram-negative, rod-like organisms isolated from similar sources and described by other workers could be readily accommodated within this classification. The classification obtained by the computer method can be considered a true taxonomy, since it is based on natural relationships determined by a consideration of all morphological, physiological and biochemical characteristics of the organisms studied.

Microfilm $2.95; Xerox $10.15. 225 pages.

HOST CELL-VIRUS INTERACTIONS IN CULTURES OF MAMMALIAN CELLS INFECTED WITH JAPANESE ENCEPHALITIS VIRUS

(Order No. Mic 61-2139)

Del Rose Marie Dubbs, Ph.D.
University of Minnesota, 1961

Nine strains of Japanese encephalitis virus were propagated serially in cultures of L mouse fibroblasts (Earle). Specific cytopathic effects were not seen in any passage although virus titers ranged from $10^{4.2}$ to $10^{7.2}$ weanling mouse LD_{50}/ml. When cultures of JE infected L cells were compared with cultures of uninfected cells, under conditions where cell growth was minimal, only small differences in cell population could be discerned by counting cells. This observed difference between infected and uninfected L cell populations was consistent with a daily destruction of 1-3.6% of cells, approximately equal to that percentage of cells from which infective virus could be recovered. Under conditions which stimulated cell growth, significant differences in cell populations between infected and uninfected L cultures were found. These differences could not be explained solely by daily destruction of less than 1% of cells, that percentage found to be associated with infective virus. Sparse L cell populations (less than 1×10^5 cells / 16 x 125 mm. test tube) were slowly destroyed by JE virus.

In infected L cultures, virus concentrations reached high levels several days before significant inhibition of cell population growth occurred. In sparse cell populations or maintaining cell populations peak virus titers appeared just prior to or coincident with a decrease in L cell population.

After 32 or 33 passages in L cells, one strain of JE virus was shown to differ from the original mouse brain virus by 1) production of visible cytonecrosis, 2) increased percentage of cells producing virus, 3) a more rapid inhibition of cell population growth, 4) quicker destruction of sparse L cell populations and 5) increased infectivity for L cells and porcine kidney cells relative to mice. Third L cell passaged JE virus was intermediate between mouse brain virus and high L cell passaged virus in its effect on L cell populations.

JE virus was also shown to propagate in 3 strains of human epithelial-like cells; Lass liver, HeLa and Stamford. Production of mouse infective JE virus in Lass liver cell cultures could be correlated with occurrence of cytopathology, although cytopathic changes often involved only 5-10% of the cells.

Two "carrier" cultures of JE virus in human liver cells were established. In the first "carrier" culture the relative pathogenicity of virus for mice and Lass liver cells remained unchanged for 30 days during 4 cell passages. Virus harvested from the 5th cell passage had increased in infectivity for Lass liver cells relative to mice

and became sufficiently cytopathic for Lass liver cells to cause total degeneration of cells in the "carrier" culture. This change in virus property was stable and transmitted to subsequent virus progeny. In a second "carrier" culture of JE virus in Lass liver cells, the relative infectivities of the virus for weanling mice and Lass liver cells remained unchanged during 6 cell passages and 60 days in culture. Virus was recovered from the cultures for 223 days but was undetectable 257, 263 and 306 days after inoculation. Microfilm $2.75; Xerox $6.00. 122 pages.

THERMOSTABILITY AND MOLECULAR DIFFERENCES IN BACTERIAL FLAGELLA

(Order No. Mic 61-2472)

Selwyn Marvin Friedman, Ph.D.
Purdue University, 1961

Major Professor: Henry Koffler

Bacterial flagella are polymers of proteins called flagellins. Flagellar suspensions are viscous, but upon heating their viscosity decreases as the polymer disintegrates into smaller subunits. With the aid of this method, Koffler, Mallett, and Adye (Proc. Natl. Acad. Sci., 43, 464-477, 1957) demonstrated that flagella isolated from thermophiles are relatively more heat stable than those isolated from mesophiles. In addition, thermophile flagella are more resistant to the effects of acid, urea, acetamide and sodium doecylsulfate.

In a study of the molecular basis for thermostability, misinterpretations may arise from differences among flagella from various organisms which are not relevant to this property. To avoid this difficulty, flagella from cells of the same organism grown at widely different temperatures were examined. Flagella isolated from cells of Bacillus coagulans strain 43P grown at 26 C exhibited a significantly greater decrease in specific viscosity when heated at 60 C than flagella isolated from cells grown at 55 C. The possibility that the population was heterogeneous and consisted of a mixture of cell types, some of which can grow only at the lower temperature and others capable of growing at the higher temperature was investigated. The data indicated that this is unlikely, and that cells of the same type were able to synthesize flagella having different properties dependent upon the growth temperature.

Tryptic digests of the two flagella preparations were separated on electrochromatograms by means of Ingram's "fingerprint" technique (Biochim. et Biophys. Acta, 28, 539-545, 1958). A comparison of the peptide maps prepared in this manner failed to reveal molecular differences between the two proteins.

The second experimental system employed flagella from Bacillus sp. strain 10, a thermophile capable of growing at 60 C, and from Bacillus sp. strain X-1, presumably a mesophilic mutant selected from cultures of the former by Prof. T. L. Thompson of the University of Nebraska, and capable of growing at 26 C. Flagella from the thermophilic "parent" maintained 92.7% of the initial specific viscosity after heating at 65 C for 25 minutes, while flagella from the mesophilic "mutant" fell to 0.3% of the initial specific viscosity under the same test conditions.

Peptide maps prepared by spotting mixtures of the tryptic digests on a single electrochromatogram indicated many similarities and several differences. Qualitative amino acid analyses of hydrolysates revealed the presence of tyrosine in eight peptides isolated after tryptic digestion of the thermophile flagella, while only one peptide isolated from the tryptic digest of the mesophile flagella contained tyrosine. The results are interpreted as a possible indication that the thermophile flagella are more resistant to the effects of heat because of more "effective" hydrogen bonding achieved through tyrosyl-carboxylate interactions. Microfilm $2.75; Xerox $4.40. 85 pages.

PROPERTIES OF FLAGELLA OBTAINED FROM THE FACULTATIVE THERMOPHILE BACILLUS COAGULANS STRAIN 43P

(Order No. Mic 61-2473)

Kenneth A. Fry, Ph.D.
Purdue University, 1961

Major Professor: Dr. Henry Koffler

Bacillus coagulans 43P is a facultative thermophile, capable of growing satisfactorily at temperatures ranging from 24 to 60° C. Crystalline alpha-amylase from this organism grown at relatively high temperatures has been reported by Campbell (Arch. Biochem. Biophys., 53, 154-161) to be more thermostable than the enzymes from organisms grown at lower temperatures. This indicates the possibility that this bacterium has the remarkable ability of synthesizing proteins having different properties dependent upon environmental conditions. Since flagella are proteins, evidence obtained from a study of the flagella from cells of this organism grown at different temperatures would help to reveal further differences that may account for the ability of certain organisms to grow at relatively high temperatures.

The results from viscosity determinations were among the first observations indicating differences in flagella grown at different temperatures. The average drop in initial viscosity of the flagella from cells grown at 55° C was less than 10% over a 25 minute period at 55° C while that for flagella from cells grown at 26°C was about 34% under the same conditions.

In order to confirm this difference in flagellar preparations, observations were made of the amount of protein precipitated from suspensions of the two types of flagella when heated to 75° C. It was found, for example, that after a 1 minute exposure to this temperature, 17% of the flagella from the mesophile had coagulated as compared with only 0.07% from the thermophile cells. This observation, along with the viscosity determinations, indicates that the former is less stable than the latter.

To test the possibility that protective or labilizing factors are responsible for this difference in heat stability the likelihood of their occurrence was estimated by the following experiments: First, viscosities of mixtures of equal amounts of thermophile and mesophile flagella, exposed to 55° C for varying lengths of time, were determined. This was done on the assumption that if the thermostable flagella contained a protective material such a substance

would also get into contact with the less stable preparation and thus stabilize it. The results obtained demonstrate that there is no significant difference between the experimental results and calculated viscosity changes for the mixtures. Second, flagella can be dissociated by acid, producing smaller units and liberating any acid-"insoluble" materials which may be present. Mixtures of equal amounts of flagella and acid-treated, then neutralized flagellar suspensions were prepared and examined. Again, there were no significant differences between the calculated and experimental results of the viscosity determinations. These observations indicate that it is unlikely that there is any protective or labilizing substance being liberated into the suspension by either type of flagella.

There is no apparent difference in the antigenicity of the two flagellar preparations, as demonstrated by the Ouchterlony diffusion plate technique. Apparently any differences which may occur are not near enough the antigenic sites to influence the stimulation of antibody production.

In order to observe differences in the amino acid sequence, if they exist, between the two types of flagella, two-dimensional electrophoretic and chromatographic peptide maps of enzyme hydrolysates were prepared. The enzymes used were trypsin, chymotrypsin, trypsin followed by chymotrypsin, and bacterial proteinase followed by trypsin and then by chymotrypsin. The ninhydrin-reactive spots which occurred were identical in size and shape for both types of flagella. Amino acid analyses of the tryptic digests demonstrate that the corresponding peptide spots on the maps from flagellar preparations had identical qualitative amino acid compositions.

Peptide maps of mixtures of mesophile and thermophile flagella were prepared and compared with maps of individual flagellar preparations. In two determinations, it was found that one peptide of the thermophile flagella gave a stronger ninhydrin reaction than the similar spot for the mesophile. This spot contained tyrosine, an amino acid which has been reported to be a participant in hydrogen bonding. This finding needs to be studied further. In any case, it is clear that the difference in the heat stability of the flagellar preparations studied is due to small, if any, differences in the primary structure of these proteins.

Microfilm $2.75; Xerox $5.80. 120 pages.

FACTORS AFFECTING THE INTERRELATIONSHIPS INVOLVED IN PROTEIN SYNTHESIS

(Order No. Mic 61-2186)

Peter B. Hill, Ph.D.
Rutgers University, 1961

Major Professor: W. W. Umbreit

The synthetic ability of isolated membranes of three bacteria--Achromobacter fisheri, Bacillus megatherium, and Escherichia coli--have been investigated. The incorporation of S^{35} methionine, C^{14} orotic acid, and labelled inorganic phosphate into the protein, nucleic acids, and phospholipids, respectively, was noted. Amino acid activation and RNA-AA complex formation were found to be located in the membranes of B. megatherium and E. coli. Treatment of the isolated membranes of B. megatherium with rattlesnake venom resulted in the reduction of incorporation of S^{35} methionine and the solubilizing of components capable of protein and phospholipid synthesis. Treatment of the membranes with butanol, desoxycholate, lipase, and rattlesnake venom indicated a lipoprotein complex was formed during protein synthesis.

The effect of streptomycin on the incorporation of labelled materials was investigated in detail with whole cells and physical fractions of whole cells of E. coli. Changes appeared in the soluble precursor components after 30 minutes' incubation, which were subsequently followed by changes in the protein and nucleic acid fractions. In the presence of streptomycin the uptake of labelled inorganic phosphate into the lipid components of isolated membranes was altered. Results indicated that the streptomycin altered the lipid metabolism thereby affecting the ability of the membrane to synthesize protein. Further chromatographic analysis of lipid extracts showed an intimate relation between the amino acid and phospholipid components.

Tobacco chloroplasts and pea root tissue were found to incorporate S^{35} methionine into their protein components. Extraction of lipid from tobacco chloroplasts caused a loss of S^{35} methionine incorporation.

After X-ray treatment the incorporation of S^{35} methionine was reduced into tobacco chloroplasts and pea root tissue. It is suggested that inhibition of the S^{35} methionine incorporation is related to the reduction in ATP synthesis after X-irradiation.

Microfilm $3.40; Xerox $11.95. 261 pages.

THE METABOLISM OF SULFATE BY THE BACTERIAL CHROMATOPHORE

(Order No. Mic 61-2376)

Manuel Luis Ibanez, Ph.D.
The Pennsylvania State University, 1961

The bacterial chromatophore has been implicated as the organ of photosynthetic activity in Rhodospirillum rubrum and other photosynthetic bacterial. The purpose of this research was to study the relationship of photooxidase to photophosphorylation and led to the discovery of a dark sulfate metabolism located on the bacterial chromatophore.

Extracts of R. rubrum were prepared to yield crude and purified chromatophores. Centrifugal analysis and electron microscopy demonstrated the relative purity of the chromatophores in these preparations. Photooxidation activity was measured spectrophotometrically as well as synthesis of adenosine triphosphate (ATP) in the light in the photophosphorylation activity. Labeled sulfate studies and carbon 14 studies involved paper chromatography methods.

Preliminary studies demonstrated that extracts irradiated with 3600 Å light lost considerable photooxidase and photophosphorylation activities. The photophosphorylation activity was completely restored by the addition of menadione. Photooxidation was not affected by menadione addition. Photooxidation has been considered an aerobic process in vitro. Data are presented demonstrating an anaerobic photooxidase in the presence of added sulfate.

Diphosphopyridine nucleotide (DPN) and ATP addition inhibit both the aerobic and anaerobic photooxidase assays. In addition, both systems show the same heat sensitivity. Sulfate added to the anaerobic system was reduced to a volatilizable form in the light. This reduction did not occur in the dark and was inhibited by ATP. The chromatophore can synthesize "active sulfate," 3'-phosphoadenosine 5'-phosphosulfate (PAPS) from ATP and sulfate. This is a dark reaction located on the chromatophore. PAPS can be synthesized from adenosine diphosphate (ADP) and sulfate, if the reaction mixture is incubated in the light. Light incubation yields ATP synthesis from ADP via photophosphorylation yielding one of the compounds needed for PAPS synthesis. Labeled sulfur as sulfate, added to reaction mixtures is reduced and transferred in small amounts to sulfur amino acids. The carbon in succinic acid (the only added carbon source in the reaction mixtures) is not utilized to synthesize sulfur amino acids on the chromatophore. This indicates that there is no net synthesis of sulfur amino acids on the chromatophore, but rather a transfer of reduced sulfur to pooled sulfur amino acids.

It has been demonstrated that incorporation of sulfate into the bacterial cell can occur on the chromatophore via the synthesis of an "active sulfate." The activated sulfate could then be reduced by other metabolic processes and incorporated into the cell. The reduction of sulfate in the photooxidase assay does not appear to depend on the formation of an "active sulfate" intermediate, since ATP inhibits the reduction of sulfate in the photooxidase assay. If PAPS were an intermediate in this reduction, the addition of ATP (required for synthesis of PAPS) should stimulate the production of reduced sulfur.

On the basis of these data it seems that there are two pathways for sulfate assimilation on the bacterial chromatophore. One involves the well known "active sulfate" synthesis, the other, a manifestation of the photooxidase assay, is the reduction of sulfate by the reducing power generated by photosynthesis. The further metabolism of sulfate must be mediated by soluble enzymes.

Microfilm $2.75; Xerox $3.60. 62 pages.

THE MICROBIOLOGICAL DEGRADATION OF STREPTOMYCIN

(Order No. Mic 61-2189)

Dolph Klein, Ph.D.
Rutgers University, 1961

Major Professor: David Pramer

The dissimilation of streptomycin by a bacterium isolated from soil and identified as a member of the Pseudomonas fluorescens group was investigated. The influence of various environmental and nutritional factors on the rate and extent of antibiotic degradation was determined and some products of the transformation of streptomycin by growing cultures and washed cell suspensions of the bacterium were identified.

The influence of various environmental and nutritional factors on the microbial degradation of streptomycin was determined as measured by the ultraviolet spectrophotometric determination of maltol, formed in stoichiometric amounts from streptomycin by mild alkaline hydrolysis. Included in these studies were the effects of size and age of inoculum, pH, buffer concentration, trace metals, streptomycin concentration, temperature, aeration, yeast extract and nitrogen source. The results provided a clear definition of conditions optimal for growth of the antibiotic-utilizing pseudomonad. The most suitable medium was one in which streptomycin served as the sole source of energy, nitrogen, and organic carbon for growth of the bacterium.

The fate of the streptidine and N-methyl-L-glucosamine moieties of the streptomycin molecule was investigated. The Sakaguchi test showed that the guanido groups of streptidine were modified and the rate and extent of streptomycin degradation were identical when determined by both the spectrophotometric and Sakaguchi methods. Transformation by the bacterium of the N-methyl-L-glucosamine moiety of streptomycin was measured by the Elson-Morgan procedure for amino sugars. Addition to the medium of an inorganic source of nitrogen did not influence transformation of the nitrogen-containing moieties of the streptomycin molecule, streptidine, and N-methyl-L-glucosamine. Apparently, each of the three moieties of the streptomycin molecule underwent simultaneous change when the antibiotic was degraded microbiologically and the bacterium did not require inorganic nitrogen for growth.

By means of several conventional biochemical tests, some products of the microbial degradation of streptomycin were detected. These reacted with ninhydrin, the phenol reagent of Folin and Ciocalteu (FCR), Ehrlich's reagent, and in acid solution, absorbed ultraviolet light with a maximum at 265 mu. Analyses of cultures demonstrated that growth, streptomycin degradation, and product formation occurred simultaneously. The ninhydrin reaction tended to intensify with time and persisted, whereas the FCR reaction and ultraviolet absorption reached a maximum and then decreased.

Reaction with Ehrlich's reagent indicated that urea was a product of the microbial degradation of streptomycin. This was confirmed by paper chromatography and by the release of ammonia from culture filtrates treated with the highly specific enzyme urease. Chromatographic analysis of concentrated cell-free culture filtrates and liquid from washed cell suspensions also revealed three ninhydrin reacting spots, one of which had an R_f value that corresponded to that of streptamine. It is suggested that the mechanism of urea and streptamine production from streptomycin is deamidination of the guanido groups of the streptidine moiety of the antibiotic molecule.

Washed cell suspensions of streptomycin grown cells were demonstrated by manometric techniques to oxidize immediately and rapidly streptomycin, dihydrostreptomycin, and hydroxystreptomycin. Although some oxygen was utilized by cells supplied with streptidine, maltol, N-methyl-L-glucosamine, streptomycin oxime and mannosidostreptomycin, the amount did not greatly exceed that required for endogenous respiration and was much less than that utilized by cells in contact with streptomycin, dihydrostreptomycin, or hydroxystreptomycin.

Washed cell syspensions reduced methylene blue more rapidly in the presence than in the absence of streptomycin, but cell-free sonicates provided with the antibiotic did not exhibit dehydrogenase activity.

Microfilm $2.75; Xerox $6.80. 141 pages.

A COMPARATIVE STUDY OF SOME ENDOCELLULAR PROTEOLYTIC ENZYMES OF AN OXIDATIVE TYPE YEAST

(Order No. Mic 61-2387)

Richard Lawrence Maginnis, Ph.D.
The Pennsylvania State University, 1961

The study reported here is the latest in a series of four investigations conducted in this laboratory concerned with the role played by Trichosporon in the ripening process of Trappist type cheese. Previous investigations have demonstrated the presence of proteinase, polypeptidase and dipeptidase activities in partially purified extracts of a yeast isolated from the surface smear. The principle question with which this study is concerned is the separate identity of the three activities. Are these really three distinct entities or merely one enzyme capable of activity on different substrates under different conditions?

Cell-free extracts were prepared by cell autolysis or alumina grinding. The process of "activation" by acid was accomplished by adjusting the cell autolysis extract to a pH value of 5.0 and allowing it to incubate under toluene for 18 hours at 25° C. The alumina grinding extract was partially purified by treatment with 2 per cent protamine sulfate. The resulting precipitate was resolubilized in 0.3 M phosphate buffer of pH 66. The degree of proteolysis of all substrates was measured by a modification of the Linderstrom-Lang titration procedure. One per cent casein and M/25 glycylglycine served as substrates for proteinase and dipeptidase activities respectively. The measurement of polypeptidase activity was measured by the degradation of a polypeptide preparation obtained by the action of Brevibacterium linens on casein.

A comparison of the proteolytic activity of extracts prepared from cells grown in media containing various concentrations of casein indicated that the enzymes under investigation were not adaptive.

It was found that cells grown in media containing 0.5 per cent Cerelose yielded extracts with the highest degree of proteolytic activity.

The proteinase activity was enhanced by "activation" by acid whereas the dipeptidase activity was inhibited by this treatment.

The three activities were found to differ markedly when extracts were heated.

Both the proteinase activity and the dipeptidase activity decreased as a result of dialysis of the enzyme extract. The polypeptidase activity was unaffected by dialysis.

The use of reducing agents (ascorbic acid and cysteine) in the reaction mixtures resulted in significant increases in the proteinase and polypeptidase activities. The dipeptidase activity was markedly inhibited by the use of these same agents.

The addition of sulfhydryl-combining reagents had no apparent effect on dipeptidase activity. Previous investigations in this series had shown these reagents to have an inhibitory effect on proteinase and polypeptidase activity.

The addition of protamine sulfate to crude extracts resulted in the precipitation of virtually all the polypeptidase activity. However, the proteinase and dipeptidase activities remained in the soluble fraction. The polypeptidase activity could be recovered completely in the precipitate with the exclusion of any demonstrable proteinase or dipeptidase activity.

These data indicate that each of the three types of proteolytic activity results from the activity of a molecular entity distinct from those controlling the other observed activities. Microfilm $2.75; Xerox $3.00. 50 pages.

THE EFFECT OF INFECTION WITH PASTEURELLA TULARENSIS ON THE METABOLISM OF WHITE RATS

(Order No. Mic 61-1481)

Gennaro John Miraglia, Ph.D.
The University of Tennessee, 1960

Major Professor: John M. Woodward

Previous workers have reported the occurrence of physiological alterations in tularemic rats as indicated by clinical studies. This thesis is concerned with a study of metabolic disturbances in rats infected with Pasteurella tularensis in an effort to elucidate more specific mechanisms responsible for these changes.

Biochemical methods were employed to follow the course of this disease in the host. It was observed that fumarase activity was decreased during infection, and while treatment with cortisone temporarily supported the activity of this enzyme, it failed to alter the death rate. Treatment with adenosine triphosphate (ATP) not only supported enzyme activity during a critical period during infection but also greatly reduced the mortality rate. Less protection was afforded by the administration of several inorganic phosphates. A delay of 24-48 hours in providing treatment with any of the compounds tested failed to change the mortality rate.

The data obtained indicates that treatment in the form of high energy phosphates provided the most significant protection in the host when treatment was initiated immediately following infection with 1 LD_{50} of P. tularensis.

The administration of ATP protected rats against the effects of 2,4 dinitrophenol, which is known to cause an uncoupling of oxidative phosphorylation. Similarly, ATP protected rats against infection with P. tularensis. These observations suggest that tularemic symptoms may result from an uncoupling of phosphorylation during the early stages of this disease.

Microfilm $2.75; Xerox $4.60. 89 pages.

A THERMOPHILIC ALDOLASE: PURIFICATION AND PARTIAL CHARACTERIZATION.

(Order No. Mic 61-1979)

Paul Joel Thompsor, Ph.D.
The University of Nebraska, 1961

Adviser: Thomas L. Thompson

Studies were made of purified diphosphofructoaldolase obtained from cells of Bacillus stearothermophilus, NCA isolate 2184. The enzyme appeared homogenous by electrophoretic criteria but the ultracentrifugal picture revealed

a trace of contaminating protein. Subsequent investigations suggested triose isomerase as the impurity in the aldolase preparation.

The bacterial aldolase was subjected to proteolytic hydrolysis tests. Ficin destroyed all enzymatic activity, whereas trypsin and carboxypeptidase had no effect on activity.

Comparisons were made between the bacterial enzyme and rabbit muscle aldolase. Hydrazine inhibited bacterial aldolase reversibly but served as an effective trapping agent in the assay of muscle aldolase. Both enzymes were found to cleave fructose-6-phosphate as well as fructose-1, 6-diphosphate under the conditions of assay employed. The rate of conversion of fructose-6-phosphate by the bacterial enzyme was about 50% that of the natural substrate.

Cobalt, zinc, and iron failed to stimulate enzymatic activity, nor did cysteine and 8-hydroxyquinoline increase the rate of substrate conversion.

Acetone powder extracts of B. stearothermophilus grown at 45° and 65° were prepared. The aldolases in these extracts were about equally stable to heating at 70° for one hour.

A heat factor was described. Heat factor was obtained from crude sonicates of B. stearothermophilus cultured at the near maximal growth temperature of 65° by treatment with ficin and extended dialysis. This factor protected the purified aldolase from inactivation at high temperatures. Attempts to protect the aldolase derived from a mesophilic mutant of B. stearothermophilus yielded varying results.

The heat factor was partially extractable in lipid solvents, refractive to DNA-ase and RNA-ase, and non-dialyzable. Microfilm $2.75; Xerox $3.00. 59 pages.

BIOGRAPHY

JOHN MAUNSELL, THE KING'S CLERK, 1230-1265.

(Order No. Mic 61-410)

Joseph O. Baylen, Ph.D.
The University of New Mexico, 1949

Supervisor: Josiah C. Russell

Appointed on July 5, 1234, to represent the king at the Exchequer of receipt, John Maunsell began his distinguished career as intimate counsellor of Henry III. Of illegitimate yet noble birth, Maunsell was educated at the royal court and enabled to become an administrator in the king's service in which, with ecclesiastical preferments, he rose rapidly. His circumspect demeanor and efficiency commended him to Henry III who, after 1234, began to substitute trained Englishmen for his Poitevin advisers.

Maunsell also became a notable soldier and, during his early career, wavered between lay and church service. However, he was permanently lamed during Henry's French campaign of 1242. Yet this mishap earned him the position of special counsellor to the king and accelerated his rise in the royal bureaucracy.

In the king's intimate council, Maunsell sought to strengthen the position of Henry III against the growing opposition of the magnates by developing a personal machine of civil servants who were dependents of the crown. By controlling royal patronage he secured the appointment of his men to the three great offices of the realm, but remained himself in the background as the king's chief counsellor. Maunsell also acquired vast landholdings which, with the income from spiritual preferments, made him one of the wealthiest men in the kingdom. Nor did he neglect his family, which shared the largess of gifts and judicial immunities.

Recognizing the value of the Holy See's support of Henry's personal government, Maunsell maintained close relations with the Roman curia. As a result, in 1261 he used his influence in Rome to secure the bulls of absolution which enabled the king to frustrate the baronial reformers. In return for his services to the curia and the king, Maunsell was rewarded with dispensations which legalized his pluralism and released him from some of Rome's more onerous exactions.

Equally talented as administrator and diplomat, Maunsell adroitly negotiated the Castilian Treaty of 1254 and astutely handled the German princes to secure Richard of Cornwall's election as king of the Romans in 1257. In the Castilian compact he not only succeeded in obtaining for Henry a valuable ally, but also dealt a blow to Gascon separatism. Yet, every advantage that he had gained for the king was cancelled by Henry's overweening ambition on the Continent. Neither Maunsell's prestige with the papacy nor his attempts to extricate Henry from the fatal Sicilian commitment could save the king from the results of his folly.

During the early part of the baronial revolt, Maunsell, realizing the inexperienced magnates' need of efficient bureaucrats to carry through their plan, prudently cooperated with the more moderate baronial reformers. Still, in spite of his limited acceptance of the reform plan, his policy was based on an awareness of the real lack of unity among the barons. He therefore took advantage of the differences between the greater and lesser barons and knights to divide the reform party and to aid Henry regain some ground lost under the Provisions of Oxford.

Maunsell's role in securing the papal bulls annulling the Provisions of Oxford completely alienated the barons. The magnates accused him of causing dissension between the king and his "natural" counsellors. But even after they had forced him into exile during June, 1863, Maunsell did not cease to serve the royal cause. His intrigues in France did much to cause Simon de Montfort to moderate the treatment of the captive king after the battle of Lewes, and together with the queen, he planned a reaction which resulted in the defeat of the baronial reformers at Evesham in 1265. It was a final justification of Maunsell's faith in a strong king and an efficient bureaucracy governing England with the aid of the barons.

Microfilm $8.65; Xerox $30.85. 683 pages.

EFFECT OF TEMPERATURE ON SPONTANEOUS AND INDUCED ACTIVITY OF ARTHROPOD NERVOUS TISSUES

(Order No. Mic 61-2458)

Paraskevi Mavridis BeMiller, Ph.D.
Purdue University, 1961

Major Professor: Richard C. Sanborn

The effect of temperature on the spontaneous activity of the isolated cardiac ganglion and the nerve cord of Limulus polyphemus and on the spontaneous and induced electrical activity of the isolated nerve cord of Periplaneta americana was investigated.

Cooling the cardiac ganglion of Limulus from 33° C. to 6° C. resulted in a decrease in the frequency of bursts of nerve activity; at 33° C. there were 23 bursts/minute while at 6° C. there were 6 bursts/minute. At 25° C., 16° C. and 10° C. the frequency of bursts was 17, 13 and 9 per minute, respectively. The duration of each burst increased from 0.6 msec at 33° C. to 6 msec at 10° C. and 6° C. At 25° C. and 16° C. each burst lasted for 2 and 4 msec, respectively.

Cooling the nerve cord of Limulus from 35° C. to 16° C. led to an increase in the level of spontaneous activity. The frequency and height of spikes were at their maximum at 16° C. Further cooling to 10° C. depressed spontaneous activity to about one-fifth of its value at 16° C. In no instance was this spontaneous activity irreversibly blocked at 10° C., as it was following a 10-15 minute exposure to 35° C.

Periplaneta was adapted to the following temperatures: 5° C. (4 days); 16° C. (6 days); 21° C. (7 and 14 days); 27° C., 32° C. (7 and 14 days), 37° C. (1 and 2 days). In all cases action potentials of low voltage were encountered in spontaneous activity records at all temperatures, whereas action potentials of higher voltage (400-800 μV) were more sensitive to temperature and were displayed only at the optimum temperature. Roaches kept at 27° C. (the rearing temperature) were considered as having undergone the most prolonged adaptation. They showed maximum spontaneous activity at 16° C. This was displayed as both maximum frequency (125/sec) and maximum height (700-900 μV) of spontaneous impulses. High spontaneous activity at 16° C. was correlated with minimum threshold voltage at this temperature.

Nerve cords from Periplaneta adapted to temperatures above 27° C., i.e., 32° C. and 37° C., showed highest frequency and voltage of spontaneous activity at 32° C. rather than 16° C. As in the case of roaches adapted to 27° C. this maximum spontaneous activity corresponded to a minimum threshold voltage for stimulation.

Results from Periplaneta adapted to temperatures below 27° C. were not conclusive. For example, nerve cords from roaches adapted to 16° C. displayed highest spontaneous activity at the temperature of adaptation but were most excitable at 37° C. This discrepancy in results was attributed to the fact that roaches kept at temperatures below 27° C. were not given enough time to become fully adapted.

Although cockroaches adapted to 5° C. for 4 days displayed a high degree of post-synaptic activity indicating some type of synaptic facilitation, the level of spontaneous activity was at a minimum at this temperature.

Microfilm $2.75; Xerox $5.00. 98 pages.

ALTERNATIVE METHODS OF SELECTION APPLIED TO PLATEAUED POPULATIONS OF Drosophila melanogaster

(Order No. Mic 61-2463)

William Paul Brown, Ph.D.
Purdue University, 1961

Major Professor: Dr. A. E. Bell

Experimental evidence is accumulating which indicates that plateaued response occurs when populations are subjected to long-term conventional methods of selection. Quite often the plateaued response is accompanied by reduced fitness of the population. One of the problems of the population geneticist and animal breeder is that of circumventing the plateau. Until it is more clearly understood, its basic causes must be investigated.

Two populations of D. melanogaster had been subjected to individual selection for increased egg number for 40 or more generations. Each population had attained an apparent plateau for the selected trait and crosses between them demonstrated heterosis which indicated that the populations were not genetically identical. Isogenic lines were extracted to estimate genetic parameters by the analyses of Griffing (1958) for diallel crossing systems. Intrapopulation analyses indicated that additive genetic variance for egg number was nearly nonexistent while non-additive variance remained large. From interpopulation analyses the reverse was true, i.e., heritability was estimated at 0.19 $\pm$ 0.06 and non-additive variance was small. The additive genetic variance in the interpopulation crossbreds represented new variance which was created by crossing the populations and had not previously been directly subjected to selection.

A large randombred population had been established from each base population. These populations served as controls to monitor environmental fluctuations. The observed means of all the experimental populations were corrected each generation for the environmental fluctuations through the controls.

Four alternative methods of selection for increased egg number were applied to the populations derived from the two plateaued populations. The experimental design provided for the simultaneous testing of 200 individuals for

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

egg number per generation for 10 generations in two replications for each of the first three methods with a selection intensity of 20 per cent.

In the first method, individual selection was applied to a new closed population formed by crossing the two plateaued populations. Selection was made on the basis of the highest individual egg number. An approximate 15 per cent gain in egg number over the plateaued levels was achieved with individual selection.

Reciprocal recurrent selection between the two plateaued populations produced a gain similar to that in individual selection. This gain was accompanied by a decline in the level of egg production in the two purebred populations.

The third method was a modification of reciprocal recurrent selection with selection based upon high individual purebred performance in addition to crossbred performance. Crossbreds were tested in alternate generations which reduced the rate of selection for the modified method. An approximate 27 per cent increase over the plateaued levels was achieved which was significantly greater than the levels attained in the first two alternatives.

Inbreeding and hybridization was the fourth method of selection. The superior interpopulation isogenic combination was chosen as the product of this method. The level of performance in the superior incrossbred compared favorably with that in the modified reciprocal recurrent method.

Evidence was obtained from covariance analyses which indicated a negative genetic correlation between purebred and crossbred egg number. This was supported by the occurrence of a decline in purebred performance with an improvement in crossbred performance. The precise nature of this relationship remains unknown until it can be investigated more thoroughly.

*Supported by a grant from the National Science Foundation. Microfilm $2.75; Xerox $6.20. 128 pages.

CHARACTER ASSOCIATION ANALYSIS IN ALFALFA

(Order No. Mic 61-2300)

Alfred Jones, Ph.D.
North Carolina State College, 1961

Supervisors: Charles Aloysius Brim and
John Wesley Dudley

A character association analysis of 13 characters in F_2 and reciprocal backcross progenies from F_1 plants of crosses between creeping-rooted (Medicago falcata type) and non-creeping-rooted (Medicago sativa type) alfalfa clones was conducted. Linear relationships of pairs of variables in the F_2 progenies were studied in 7,965 scatter diagrams. Multiple associations suggested by study of the linear associations were analyzed in the F_2 populations by means of 465 pictorialized scatter diagrams representing three to eight characters each. Tendencies noted in the F_2 populations were tested in reciprocal backcross progenies of the F_1 plants and their respective parents by means of 211 pictorialized scatter diagrams. The F_2 study contained a total of 5,310 plants representing 177 F_2 progenies and the backcross study contained 4,405 plants representing reciprocal backcrosses between six F_1 plants and their respective parents.

No three-way or greater associations were noted in the F_2 and backcross populations which would indicate difficulty in selection of plants containing desired combinations of the traits studied.

The patterns obtained in the pictorialized scatter diagrams show no genetic barriers to free interchange of genetic material between the two divergent types of parents, supporting previous cytological data indicating that the M. sativa and M. falcata are not distinct species but are widely divergent forms of the same species.

The method of pictorialized scatter diagrams was found not to be particularly well suited for study of large populations but would seem to be very useful in preliminary studies of large populations or in studies of populations too small for conventional statistical analysis.

Effectiveness of alcohol emasculation was compared to that of suction emasculation. The suction technique was found to be superior to the alcohol technique in three ways; a higher per cent of the flowers worked set seed, the number of seed per pod was higher, and results from the checks (emasculated but not pollinated) indicated less chance of accidental pollination with the suction technique.

Seed set on selfing was significantly correlated with that on outcrossing ($r = .85^{**}$). Therefore, compatibility indexes were computed as:

$$\text{Compatibility index} = \frac{\text{seed/flower when selfing or backcrossing}}{\text{seed/flower when outcrossing}} \times 100$$

Comparisons of backcross-compatibility indexes suggested the presence of an incompatibilty system which acts differentially in the pistillate and staminate parents.

In the parent and F_1 populations pollen count was not significantly correlated with selfed seed set ($r = .44$), outcross seed set ($r = .36$) or with the self-compatibility index ($r = .52$). Microfilm $2.75; Xerox $4.60. 87 pages.

INHERITANCE OF RESISTANCE TO FUSARIUM WILT IN UPLAND COTTON

(Order No. Mic 61-2124)

Jack Earl Jones, Ph.D.
Louisiana State University, 1961

Supervisor: Professor M. T. Henderson

Inheritance of resistance to Fusarium wilt was studied in several plantings of the parents, F_1, F_2 and F_3 populations of 2 crosses between resistant and susceptible strains of Upland cotton. Half and Half was the susceptible parent in both crosses. Delfos 425 was the resistant parent in one cross and Coker 100 Ga. was the resistant parent in the other. All populations were grown in the field on soil naturally infested with Fusarium wilt and the reniform nematode. Plants were classified for degree of infection

based on both vascular discoloration and leaf symptoms of the disease.

The parents of each cross differed widely in their reaction to wilt. Most of the plants of Delfos 425 and Coker 100 Ga. were either free of wilt symptoms or had only light vascular discoloration. Most of the plants of Half and Half had moderate to severe leaf symptoms of wilt. There was, however, some overlapping in the distribution of parent plants; the extent of overlapping varied with the planting.

The F_1 generation of each cross was very variable in its reaction to wilt. F_1 plants occurred in every wilt class. The average degree of infection, however, was somewhat intermediate between the parents. In no case did the F_1 generation show complete dominance for resistance or susceptibility.

The continuous variation among individual F_2 plants and F_3 line means, in each cross, indicated that resistance to wilt should be considered as a quantitative character, although the frequency distribution of F_2 plants and F_3 line means was not entirely typical for such a character. The frequency of probable parental recoveries in the F_3 generation of both crosses indicated that the parents differed in their wilt reaction by at least 2 but probably no more than 3 pairs of genes. The behavior of F_2 plants and F_3 lines suggested that these 2 or more pairs of genes were not equal in their effects on resistance. The full resistance of Delfos 425 and Coker 100 Ga. appeared to have been due to a major pair of genes plus one or more pairs of minor or modifying genes.

Estimates of heritability for resistance to wilt were high in the Delfos 425 x Half and Half cross but low in the Coker 100 Ga. x Half and Half cross as measured by parent-offspring correlation and regression. The inconsistency in the results may have been due to variations in the severity and uniformity of wilt-infection between the 2 different F_2 populations.

Studies were also made in the parents, F_1 and F_2 populations of the Delfos 425 x Coker 100 Ga. cross in an effort to determine whether genes for resistance to wilt occurred at the same or at different loci in the 2 wilt-resistant strains. The F_2 population failed to give conclusive evidence in this regard due to the nature of wilt infection.

Microfilm $2.75; Xerox $6.00. 124 pages.

THE EFFECTS OF LINKAGE BIAS ON ESTIMATES OF GENETIC VARIANCE AND THE AVERAGE DEGREE OF DOMINANCE FOR GENES INFLUENCING QUANTITATIVELY INHERITED CHARACTERS IN THE F_2 AND ADVANCED GENERATIONS OF A HYBRID POPULATION OF CORN

(Order No. Mic 61-2291)

Marvin Frederick Lindsey, Ph.D.
North Carolina State College, 1960

Supervisor: Harold Frank Robinson

This investigation was undertaken to detect and evaluate the effects of linkage bias on estimates of genetic variances and the average degree of dominance for genes influencing yield, ear number, ear diameter, ear length, ear height, plant height, and date of flower in the F_2, F_8, and F_{13} generations of the cross of two inbred lines of corn.

Plants chosen at random from the three generations of material were backcrossed to each parent line. The backcross progenies were grown in replicated field experiments. The final analyses of variance enabled the estimation of components of progeny variance from which estimates of additive genetic variance, σ^2_g, and dominance variance, σ^2_d, were obtained.

Estimates of the average degree of dominance, $\bar{a}$, for genes influencing yield in F_2 generation material were in the overdominance range ($\bar{a} > 1.0$) and statistically significant. Similar estimates of $\bar{a}$ based on F_8 and F_{13} generation material were reduced in magnitude to values not significantly different from complete dominance ($\bar{a} = 1.0$). Estimates of $\bar{a}$, for characters other than yield, were in the range of partial to complete dominance ($0 < \bar{a} \leq 1.0$) in the F_2 generation and declined to values in the partial dominance range ($0 < \bar{a} < 1.0$) in F_{13} generation material.

Comparisons of Inbred line x F_n parent mean squares from F_2, F_8, and F_{13} generation analyses for yield, ear number, ear diameter, ear length, and date of flower indicated significant reductions in the estimates of dominance variance as generations were advanced by random mating. The reductions in $\hat{\sigma}^2_d$ and $\hat{\bar{a}}$ conform to the results expected if linkage bias, especially repulsion phase linkage, is present.

The results of a limited amount of data indicated that yield and ear length were subject to considerable genotype-environmental interaction effects. The estimates of σ^2_g for these characters showed a greater proportional reduction than estimates of σ^2_d when environmental interactions were removed. Similar estimates for other characters showed little effects due to environmental interactions.

No detectable effective change in the frequency of genes concerned with yield was indicated as the plant material was advanced from the F_2 to the F_{13} generation. Changes were observed in the mean performance of the other characters. Although the changes may have been due to fortuitous selection, random genetic drift appeared to be the most feasible explanation. However, major changes must occur in gene frequency to seriously affect the estimates of $\bar{a}$.

The decrease in the values for $\hat{\bar{a}}$, together with the significant reductions in $\hat{\sigma}^2_d$, furnished a basis for concluding that linkage results in upward bias in these estimates, especially in F_2 generation material. The advancement of the material to the F_{13} generation provided opportunities for genetic recombination to occur between linked loci. Subsequent reduction in the amount of linkage disequilibrium caused a reduction in linkage bias. The values of $\hat{\bar{a}}$ in the F_{13} generation support the hypothesis that yield in corn is largely under the influence of genes exhibiting partial to complete dominance. The possibility of overdominant loci cannot be denied. However, data from F_{13} generation material become less favorable for the overdominance hypothesis.

The presence of pseudo-overdominance effects due to repulsion phase linkages do not appear to seriously hinder the increase in frequency of favorable alleles at two linked loci in a selection program.

Microfilm $2.75; Xerox $5.60. 114 pages.

A STUDY ON THE EFFECTS OF STREPTOMYCIN ON MAMMALIAN CELLS IN CULTURE AND A STUDY ON THE SEPARATION OF GROWTH PROMOTING MATERIAL FOR CELL CULTURES FROM HORSE SERUM BY DIALYSIS

(Order No. Mic 61-2490)

Don Phillip Metzgar Jr., Ph.D.
Purdue University, 1961

Major Professor: Merwin Moskowitz

There were two principle sections of the research. In the first series of studies, the properties of mammalian cells resistant or sensitive to toxic concentrations of streptomycin were studied. In concentrations of three mg per ml of nutrient medium or more, streptomycin has a toxic effect on mammalian cells in culture which results in their death. Strains of cells resistant to streptomycin have been obtained by subculturing cells from colonies that grew in toxic concentrations of streptomycin, and both resistant and sensitive strains of cells were derived from single cells of the parent culture.

This resistance and/or sensitivity appears to be genetically determined since these characteristics have remained unchanged after several years of culture in the absence of streptomycin from the medium.

A most interesting property exhibited by certain resistant strains was that when two of these strains were mixed together and exposed to streptomycin the mixture of cells was sensitive to the streptomycin.

The manifestation of sensitivity and/or resistance was found to be affected by the environment; that is the degree of sensitivity and/or resistance manifested could be altered by changing the composition of the growth medium.

Exposure of sensitive strains to toxic amounts of streptomycin resulted in its release of material into the medium which absorbed at 260 mμ in the spectrophotometer. This phenomena did not occur when resistant strains were treated in the same manner. Mixtures of two resistant strains also resulted in the accumulation of the 260 mμ material in the supernatant growth fluid. The release of the 260 mμ material was closely correlated with sensitivity.

In the second series of studies, the separation of a protein-free fraction from horse serum having growth promoting activity for cell culture was studied. When serum was dialyzed for prolonged periods of time at 37°C against an equal volume of synthetic medium or a salt solution the dialysate, in certain instances, could substitute for the serum supplement in growth medium. Dialysates were obtained which gave growth responses of from 30 to 115% of the response achieved with whole serum. Under these conditions, dialysis was carried out up to 144 hours before maximum response was achieved.

Preheating of the serum for 7 days or longer prior to dialysis resulted in achieving responses of from 70 to 100% after 48 to 72 hours of dialysis.

Further studies showed that the amount of growth promoting activity obtained varied considerably with different lots of horse serum. The condition of the glassware as well as the pH at which dialysis was carried out were found to be critical.

Dilution of the serum prior to dialysis with distilled water or salt solutions enhanced dialysis. Denaturation of the serum protein with heat, acid, or base hydrolysis did not enhance activity but did not diminish activity either.

The growth promoting activity was remarkably stable at high temperatures (100°C for 30 minutes).

Crude separation by paper chromatography resulted in the separation of the dialysate into six bands of ninhydrin positive material, three of which had activity.

Activity was not confined to serum proteins. General proteins in the form of enzymes also manifested activity upon being dialyzed. Enzymatic treatment of the serum prior to dialysis only slightly improves activity.

Concentration of dialysate activity was achieved by evaporating dialysates over steam. This preparation gave responses equal to that of serum.

Microfilm $2.90; Xerox $10.15. 222 pages.

INHERITANCE OF GROWTH HABIT AND FLOWERING RESPONSE OF THE SOUTHERN PEA, Vigna sinensis, ENDL.

(Order No. Mic 61-2126)

Joseph Daniel Norton, Ph.D.
Louisiana State University, 1961

Supervisor: Dr. Julian C. Miller

The purpose of this research was to determine the effects of photoperiod upon the growth habit and flowering of Southern pea plants. Growth habit and flowering response under different day-length were also recorded for the F_1, F_2 and F_3 plants.

Based on previous observations, variety trials and breeding studies, seven varieties (Alabunch, Vigna cylindrica, Winter Pea, Burma Pea, Cabbage Pea, White Kadoorie and Running Acre) were selected for breeding work from observational field plantings from spring to fall of 1956. These varieties were planted in greenhouse beds on December 19, 1956.

Seed obtained from the greenhouse crosses (Alabunch x Vigna cylindrica, Winter Pea x Burma Pea, White Kadoorie x Cabbage Pea and Running Acre x Cabbage Pea) were planted in the field on March 17 to obtain seed for the fall planting. The F_1, F_2 and F_3 were planted together in field plots of Arredondo Fine Sand at the University of Florida Horticultural Unit on September 15, 1957. Another planting was made on April 15, 1958, which contained the same plant material. Two additional field plantings were made, September 15, 1959, and April 15, 1960, in which the Winter Pea x Burma Pea cross was taken into the F_3.

Greenhouse experiments were conducted at Louisiana State University during the winter of 1959. Parental varieties, four crosses and reciprocal crosses were grown in light chambers with 10, 12 and 14 hours of daily illumination. Each received 10 hours of natural daylight with the additional illumination supplied by daylight fluorescent light at 500 foot-candle power. Grafting studies were carried out in each of the light chambers above in an effort to translocate the flowering stimuli from the scion to the rootstock.

Differences in growth habit were observed when the spring crop was compared with the fall planting. In the fall planting, parental varieties, F_1 and F_2 plants were taller

with less width than similar plants when grown as a spring crop.

When the progenies were compared with the parents, differences in growth habit were also observed. The F_1 were semi-vining plants which were taller and wider than the parents. Two pairs of alleles which control plant growth habit were involved, one for vining VV and one for tall TT.

The flowering response varied with the different planting dates and crosses. Three varieties (Alabunch, Burma Pea and Cabbage Pea) flowered abundantly in the spring and sparsely in the fall. In contrast, three varieties (Vigna cylindrica, White Kadoorie and Running Acre) flowered sparsely in the spring and abundantly in the fall. One variety (Winter Pea) did not flower in the spring; however, it flowered profusely in the fall. The F_1 plants produced more flowers in the spring and less flowers in the fall than the most abundant and sparse flowering parents.

In the F_2, abundant and sparse flowering plants were present in approximately a 3:1 ratio in the spring; the ratio was reversed in the fall.

In the F_3, seed from F_2 plants which flowered abundantly in the spring produced plants which flowered abundantly and sparsely in the fall in approximately a 1:7 ratio. Seed from sparse flowering F_2 plants in the spring produced only abundant flowering plants in the fall.

In greenhouse studies, growth habit and flowering in the 10 and 14 hour chambers were similar to that observed in the field in the fall and spring. Plants with the 12 hour treatment were intermediate in growth habit and intermediate to greater in flower production.

In graft studies, flowering varied with the stock, scion and light chambers.

Pod and seed production followed the same trend for flower production in the field and greenhouse experiments.

Microfilm $2.75; Xerox $6.60. 140 pages.

QUANTITATIVE GENETICS OF HEIGHT IN brachytic$_2$ CORN

(Order No. Mic 61-1659)

Wolf Prensky, Ph.D.
University of Illinois, 1961

The purpose of this study was to estimate the additive and dominance components of variance of height characters in brachytic$_2$ corn, and to study the validity of these estimates.

Materials used were br$_2$/br$_2$ derivatives of Illinois High Ear (IHE), Illinois Low Ear (ILE), and Krug Yellow Dent (KYD). IHE and ILE were two strains selected for high and low ear height during 27 generations of selection. The study was conducted on populations resulting from crosses of the above strains to two brachytic$_2$ inbred lines, R909B and R906. The populations consisted of series of testcrosses, backcrosses, and intercrosses of all of the basic populations.

Linear models were derived for the study of specific intra-allelic effects (i.e. additive and dominance) in related multiparental populations. The study of the models depended on a regression analysis of the difference between the means of related populations over several generations. Linear regression in the models accounted for all intra-allelic effects present in the population if the occurrence of multiple allelism is excluded.

Regression analyses were performed on series of backcross and testcross progenies, the linear component in these analyses being due to both additive and dominance effects simultaneously.

Biological controls were employed to give an indirect indication of the reliability of the procedures used. These included imperfect control of gene frequencies due to the heterogeneity of populations derived from KYD and the regression analysis of models in which the sum of the intra-allelic effects would not necessarily result in linear relationships.

It was found that over 90% of the variance between populations was associated with additive and dominance effects in the testcross progenies of IHE and ILE. Linear regression was not significant when the analysis was based on the average performance of KYD testcross populations. An examination of individual progenies revealed the presence of significant intra-allelic and inter-allelic effects in almost all populations.

The fraction of the variance associated with linear regression was smaller when additive or dominance effects were studied separately. The relative frequency of significant linear regression coefficients was lower when these intra-allelic effects were studied separately than when they were studied together. Models with non-linear effects implied in their construction yielded results essentially similar to those obtained from linear models. Also, no appreciable change in the results was noted when derivatives of KYD were tested in the models. The inference was made that the presence of linear relationships depended to a large extent on the level at which a phenotypic variable was measured.

No consistent association was observed between the prevalence of non-linear effects in the regression analysis and simultaneous difficulties in the computation of variance components. The estimates of variance components obtained for ear height in ILE crosses were unreasonable. This may have been due partly to the fact that the study was conducted on br$_2$ material, and partly to the presence of large amounts of epistatic effects in ILE populations. The magnitude of epistatic effects varied considerably in various populations, and the estimates of additive and dominant gene action probably incorporated such effects. Several violent fluctuations in the magnitude of the estimates of the separate components when data were transformed to the logarithmic scale may also have been due to the effects of epistasis on the expression of a given character. However, since data transformations were not effective in materially changing the presence of quadratic or cubic regression, it was concluded that transformations as such will not remove epistatic effects from the data.

Microfilm $2.75; Xerox $7.40. 159 pages.

STUDIES ON THE CELLULAR COMPOSITION AND GERMINATION OF MICROSCLEROTIA OF VERTICILLIUM ALBO-ATRUM R&B

(Order No. Mic 61-2498)

Thomas Richard Pyke, Ph.D.
Purdue University, 1961

Major Professor: C. L. Porter

An investigation of the cellular composition and germination of microsclerotia of the Purdue isolate 25A of Verticillium albo-atrum was conducted in an effort to gain information into the behavior of these structures in nature. The initial research approach concerned a study of the effects of heat and heat plus desiccation as it affects germination rate in an attempt to heat-inactivate the hyphal elements which are present on microsclerotia when removed from a plate colony. A water suspension of microsclerotia was immersed in a 50° C. water bath for various time intervals. It was found that temperatures which are lethal to conidia and hyphae also affect microsclerotia to some degree.

An attempt was made to prepare hyphae-free, uniform-sized samples of microsclerotia by mechanical means. A water and fine sand mixture containing two 8 week old Verticillium colonies grown on cellophane at 25° C. with a relative humidity of 85 ± 5% and shaken 4½ hours at maximum speed on a wrist action shaker was found to be superior to other systems tried. Uniform samples were collected on a #200 wire mesh screen after washing with liter quantities of sterile deionized water to remove both larger and smaller particulate materials.

The per cent germination and the average number of germ tubes per germinated microsclerotium were determined by plating a typical sample on Czapek's solution agar and incubating for 18 hours at 25° C. The sample showed 89.9% germination with an average of 10.2 germ tubes per germinated microsclerotium. It was concluded that germination of microsclerotia cannot be explained merely as the growth of adhering hyphal elements since a majority of the microsclerotia prepared by the sand-screen process are free from surface mycelium.

The relationship of age of culture to ability to withstand heat-treatment in an aqueous suspension was determined. One ml. suspensions of microsclerotia which were 1, 2, 3, 4, and 5 weeks old were immersed in a water bath at 50° C. for 10 minutes followed by immediate cooling. Each suspension was plated out and the results of the treatment were observed. It was found that no germination was observed after 18 hours of incubation in the heat-treated samples while all of the non-heat-treated samples germinated in this time period. After 10 days, the number of colonies appearing in the heat-treated samples was proportional to the age of the sample. Sclerotization was proportional to age also indicating that the older samples germinated more quickly than the younger samples after heat-treatment.

Commercial Chlorox was observed to decolorize microsclerotial samples completely. This finding was used in a study of the cellular composition of the microsclerotial masses which result from preparation by the shake-screen process. The results were recorded on photomicrographs. It was found that microsclerotia are composed mostly of dark, thick-walled cells which are round in outline. Also, there are cells which are thin-walled and less darkly pigmented and a few which are oblong in outline. The Chlorox affected the cell walls by causing a sloughing off of the outer wall layer. After violent agitation some cells were observed to break free from the sclerotial mass. Germinated microsclerotia were studied by the same methods. It was found that many germinated cells break away during Chlorox treatment, and after staining, appear as small, globose, thin-walled cells similar to germinating conidia. Intact germinating cells were observed also which were similar to typical dark, thick-walled microsclerotial cells except they were both lighter in color and thin-walled.

The nature of the structural component of the cell walls was investigated. Cell wall preparations were treated 11 hours in 1 N KOH at 95° C. followed by 28 hours with 6 N HCl at 95° C. The method of Dische and Berenfreund was used for a qualitative analysis for hexosamines. Hexosamines were present and it was concluded that the walls were chitinous in nature. The nature of the pigment was investigated also. By its solubility properties, its behavior in oxidizing agents, and its absorption spectrum, it was concluded that the pigment was a melanin.

Microfilm $2.75; Xerox $4.60. 88 pages.

THE EFFECTS OF COBALT 60 GAMMA RADIATION ON MICROSPOROGENESIS AND MALE GAMETOPHYTE DEVELOPMENT IN TOMATO (Lycopersicon esculentum Mill.)

(Order No. Mic 61-2243)

Mahendra Singh, Ph.D.
The University of Florida, 1961

The physiological effects of Cobalt 60 gamma radiations on tomato microspore development, nuclear differentiation, chromosomal aberration, germination and subsequent pollen abortion in the X_1 generation have been studied. The exposure of pre-meiotic inflorescences to gamma ray dosages of 600r, 800r and 1,000r resulted in degeneration of the anthers, meiotic chromosomal aberrations and consequent pollen abortion. Buds exposed to 800r dosage were selected for further cytological studies. It was observed that the sensitivity to ionizing radiations was more dependent on bud size than upon the dosage within the range employed.

Chromosome fragmentation was used as a measure of radiation damage. Early prophase and metaphase II stages were found to be most sensitive (about 94 per cent). The irradiation of cells in early meiotic stages produced the highest degree of microspore sterility (82.8 per cent). There was constant increase in pollen abortion with the increasing dosage whereas the radiation effect decreased with increasing bud size.

Failure of germination of morphologically normal pollen grains suggested that radiation induced either gene mutations or large chromosomal changes in the vegetative nucleus. The fertilization of the untreated eggs by male gametes from irradiated pollen resulted in X_1 individuals which exhibited higher percentages of pollen abortion than the plants having no history of irradiation. The amount of pollen abortion in these X_1 plants increased in a linear fashion with increasing gamma dosage.

The results obtained indicate that the 4,000 to 7,000r range is probably an optimum threshold value which would take into account a practical balance between mutation frequency and seed production efficiency. The greatest practical efficiency from irradiation of any stage in the haploid cycle of tomato plant development would be derived from the irradiation of the microspores although premeiotic stages of microspore development have been found to be more radiosensitive.

Microfilm $2.75; Xerox $4.80. 95 pages.

A QUANTITATIVE STUDY OF THE EFFECTS OF SINGLE DOSES OF ULTRAVIOLET LIGHT ON MOUSE SKIN

(Order No. Mic 60-5058)

Gerald A. Soffen, Ph.D.
Princeton University, 1960

Ears of Strain A male albino mice were irradiated with ultraviolet light. The source was either a low pressure mercury arc or intermediate pressure mercury arc. Several different doses were used in the experiments. Control experiments were performed to determine the effect of certain variables. Irradiated ears were fixed at various times post-irradiation, and histological slides were prepared. Examination of these slides shows that both sources of ultraviolet light produce the same qualitative effects. Quantitative measurements were made of six changes in irradiated and unirradiated tissues: a) increase in number of epidermal cells, b) increase in number of mitotic figures, c) numbers of groups of mitotic figures, d) increase in diameter of nuclei, e) increase in thickness of epidermic, f) increase in thickness of dermis.

The course of hyperplasia and the dose relationships were analyzed. The shape of the curves is the same for the intermediate pressure arc and the low pressure arc, but the effect of dose differs. This difference may be accounted for largely, or altogether, on the basis of the difference in penetration of the two types of radiation. The evidence suggests that after irradiation by ultraviolet light a small fraction of the epidermal cells divide very rapidly for several divisions, after which the proliferation rate returns gradually towards normal. The significance of the pattern of hyperplasia is discussed.

Microfilm $2.75; Xerox $5.80. 117 pages.

THE RELATIVE EFFICIENCY OF EAR-TO-ROW SELECTION AND CONVERGENT IMPROVEMENT BREEDING IN THE DEVELOPMENT OF SUPERIOR SWEET CORN INBREDS AND THEIR HYBRIDS

(Order No. Mic 61-2196)

Valentin Ulrich, Ph.D.
Rutgers University, 1961

Major Professor: Robert S. Snell

Ear-to-row and convergent improvement breeding were compared on the basis of the performance of six sweet corn inbreds and six of their hybrids. Inbred performance was based on changes in seed production and changes in bacterial wilt and stalk rot resistance. Hybrid performance was based on changes in plant and ear height, and ear length, diameter and number.

Ear-to-row selection was ineffective in improving poorly adapted or disease susceptible inbreds like C13, C22 and 143y. Convergent improvement increased the wilt resistance of C13, 143y and 116 when P39 was used as a nonrecurrent parent. However, the use of the former inbreds as nonrecurrent parents resulted in a decline in wilt resistance of recovered P39 lines. Ear-to-row selection was more effective than convergent improvement in maintaining good characteristics in well adapted, disease resistant lines. Convergent improvement breeding was very effective in producing more stalk rot resistant lines of C22 and C13 because transgressive segregation occurred for factors conditioning resistance. As a result of increased stalk rot resistance seed production was greatly improved in C22. Stalk rot resistance was also improved in recovered P39 lines when 143y, 116 and 7y were used as nonrecurrent parents. The seed production potential of P39 was greatly improved when 116 and 7y were used as nonrecurrent parents.

The use of P39 and C22 as nonrecurrent parents of early maturing C13 resulted in the isolation of convergent improved lines with later dates of maturity.

The performance of convergent improvement hybrids derived from crosses of well adapted and poorly adapted lines was superior to those derived from ear-to-row selection lines. Although inbred performance of P39 convergent improvement lines was inferior when C13 and 143y were used as nonrecurrent parents, combining ability was effectively recovered.

Convergent improvement hybrids derived from crosses of poorly adapted lines C22 x C13 and 143y x C13 resulted in the isolation of hybrids that were superior to the control, C13 x 143y. Ear-to-row hybrids of C22 x 143y rarely displayed improved performance. With 143y x C13, neither ear-to-row selection nor convergent improvement breeding resulted in new crosses that displayed outstandingly better performance than the control.

The last two hybrids in the study, P39 x 116 and P39 x 7y, were derived from well adapted lines. Larger ear size was desired in both hybrids but this objective was not attained by either breeding system in P39 x 116. However, ear-to-row hybrids did not display as large a retrogression in performance as convergent improvement hybrids. With P39 x 7y, increases in both ear length and width were accomplished by convergent improvement breeding.

However, these increases were associated with significant decreases in ear number. With ear-to-row selection a considerable loss in ear width occurred. Probably convergent improvement was slightly superior to ear-to-row selection with the latter hybrid.

Microfilm $3.95; Xerox $13.95. 308 pages.

BOTANY

A STUDY OF SOME PHYSIOLOGICAL PROCESSES OF CORN AS AFFECTED BY N-(3,4-DICHLOROPHENYL) METHACRYLAMIDE.

(Order No. Mic 61-2122)

Henry Hanly Funderburk, Jr., Ph.D.
Louisiana State University, 1961

Supervisor: Professor Walter K. Porter, Jr.

Some effects of N-(3,4-dichlorophenyl) methacrylamide (dicryl) on corn were investigated. Dicryl caused a slight reduction in length of corn coleoptiles while IAA caused an appreciable increase in elongation. The herbicide had no influence on elongation of coleoptiles which were also treated with IAA. It was found that both roots and shoots were affected when dicryl was applied to roots of corn.

Plant material for the remainder of the investigation was obtained by treating 5 to 6 day old corn seedlings which were grown in soil in metal flats with 0 and 3 lb/A dicryl. It was found that dicryl caused a sudden decrease in the respiration of corn leaf tissue. The rate of respiration of control tissue steadily decreased during the testing period. Low rates of DNP caused stimulation of respiration while higher rates caused inhibition. Treated tissue was much more sensitive to DNP than control tissue.

Phenol oxidase was the most active of the terminal oxidases. Negative results were obtained for the participation of the cytochrome system in the respiration of corn. Homogenates from corn tissue readily oxidized ascorbate but the oxidation was thought to be of a nonenzymatic nature.

Dicryl caused little effect on the activity of catalase 2 days after treatment, but 6 days after treatment it caused a 50 per cent reduction in activity. The herbicide had essentially the same effect on peroxidase and glycolic acid oxidase activity.

Three to 4 days after corn was treated with dicryl there was a sudden increase in the oxidation of ascorbic acid which continued to rise throughout the testing period. The oxidation of ascorbate by homogenates from both control and treated tissue was slightly increased by boiling as well as by the addition of $CuSO_4$. Heavy metal inhibitors affected the oxidation of ascorbate very little; however, iodoacetate caused considerable inhibition. The batch treatment of supernatants with a cation exchange resin had little or no effect on the oxidation of ascorbate and the possibility of ascorbate serving as a source of electrons for the reduction of quinones proved negative. It was also determined that neither dehydroascorbate nor hydroquinone could substitute for ascorbate.

Dialysis studies indicated considerably more nitrogen was lost from dialyzed treated than from dialyzed control supernatants. When homogenates were fractionated by centrifugation, it was found that considerably more nitrogen was precipitated in control than in treated homogenates. In the same experiment it was found that centrifugation had little effect on the oxidation of ascorbate.

Some of the techniques utilized in the investigation were checked on cucumber ascorbic acid oxidase. The oxidation of ascorbate by cucumber extract could be inhibited by boiling and by 0.2 mM dieca.

The oxidation of ascorbate was affected very little when alanine, asparagine, and glutamine were added to homogenates at low concentrations but at high concentrations (0.1M) glutamine and asparagine caused some inhibition. The effect of glutathione on the oxidation of ascorbate was the same as that encountered with the higher concentrations of amino acids.

Supernatants (1,000 xg) from homogenates were fractionated by the use of a column of celite. Some fractions, which were of a brownish color, oxidized ascorbate quite rapidly. The color was separated from ascorbate activity by chromatography on a 98 per cent celite – 2 per cent charcoal column. Copper greatly increased the oxidation of ascorbate in all fractions from the celite – charcoal column except the ones which exhibited ascorbate activity prior to the addition of copper and the ones which contained the brown color.

Microfilm $2.75; Xerox $4.80. 92 pages.

STUDIES ON THE INHIBITOR RESISTANT RESPIRATION OF THE MYCELIUM AND PARTICULATE EXTRACTS FROM MYROTHECIUM VERRUCARIA

(Order No. Mic 61-2043)

George W. Kidder III, Ph.D.
University of Pennsylvania, 1961

Supervisor: David R. Goddard

The respiration of Myrothecium verrucaria, one of the imperfect fungi, was shown by Darby and Goddard (1950) to be insensitive to cyanide and carbon monoxide, and somewhat insensitive to azide. These inhibitors normally act by blocking cytochrome oxidase, and as these authors had demonstrated the existence of cytochrome oxidase activity in extracts of the fungus, and had shown that this extracted oxidase was sensitive to low concentrations of all three inhibitors, an attempt was made to elucidate the mechanism of the insensitivity of the intact mycelium.

The experiments of Darby and Goddard were confirmed and extended, through the use of the oxygen polarograph.

Cyanide and azide were found to be inhibitors at high concentrations, and independent of the oxygen concentration. Carbon monoxide, which Darby and Goddard did not observe to be inhibitory in their manometric measurements, was found to inhibit only at CO/O_2 400, although this value is somewhat uncertain. Antimycin A was found to be inhibitory only at low oxygen tensions.

Particles of unknown morphology, but simular to mitochondria in their preparation and reactions, were prepared from the mycelium by a method described, using mannitol-phosphate buffers and hand grinding with sand. These particles respire succinate, citrate, -ketoglutarate, and oxalacetate at reasonable rates, DPNH at a higher rate, and act as a cytochrome oxidase toward added cytochrome c. The addition of ADP with citrate, -ketoglutarate or oxalacetate gives an increase in rate.

Tests of the sensitivity of the respiration of these particles to the above-mentioned inhibitors were performed. Cyanide and azide behaved toward the succinate respiration as toward the whole cells, carbon monoxide was without effect, and antimycin A completely inhibited the respiration at low concentrations. With added cytochrome c as a substrate, however, low concentrations of cyanide and azide would inhibit the respiration 50%, but not even very high concentrations would reduce the rate below about 20% of the control rate. Carbon monoxide at a CO/O_2 of 20 blocks this reaction, and this inhibition is photoreversible. Antimycin A was without effect on the added cytochrome c oxidation.

Spectroscopic observation of the particulate preparations at liquid nitrogen temperature shows the existence of apparently normal cytochrome c, a and a_3 pigments with alpha bands at 546 and 599 at this temperature. Three cytochrome b type pigments can also be seen, at 554, 559 and 560. This cytochrome system appears normal in all respects; there is no indication spectroscopically of the reason for the resistance to the inhibitors.

Thus the inhibitor resistance of the mycelium is reflected in the same resistance in the mitochondria, although no conclusions can be drawn as to the exact reason for this resistance. It is concluded that the explanation probably lies in the 20% uninhibitable cytochrome c oxidase activity on the one hand, or in the apparently autoxidizable b pigments on the other. The evidence given here, as for the other cyanide insensitive systems known, does not permit a decision between these two hypotheses.

REFERENCE

Darby, R. T., and D. R. Goddard (1950). The effect of cytochrome oxidase inhibitors on the cytochrome oxidase and respiration of the fungus Myrothecium verrucaria. Physiol. Plantarum 3:435-446.

Microfilm $2.75; Xerox $4.20. 80 pages.

THE CROSSING BEHAVIOR AND CYTOGENETICS OF MIMULUS GUTTATUS FISCHER IN THE BONNEVILLE BASIN

(Order No. Mic 61-388)

Delbert William Lindsay, Ph.D.
University of Utah, 1961

Chairman: Robert K. Vickery, Jr.

This is a study of the effects of Pleistocene Lake Bonneville and its climatically associated glaciers upon the evolution of the common monkey flower, Mimulus guttatus. Following the disappearance of the last fresh water lake from the Bonneville Basin a little less than 12,000 years ago and the retreat of the canyon glaciers new habitats were made available which the monkey flower has been successful in occupying. Five canyon drainages were sampled at each of the following levels: (a) within the ancient lake bed, (b) at or near the ancient lake level, (c) in areas that were not disturbed by glaciation and (d) in areas once covered by Pleistocene glaciation. A control population from Contra Costa Company, California, was also included.

Experimental work was conducted with greenhouse cultures of natural populations. Most cultures displayed subtle morphological distinctions and some cultures yielded statistically significant measurements of height at maturity, dry weight at maturity and time in days from planting to production of ripe seed capsules. These effects appear to be the results of isolation and the accumulation of genetic peculiarities. In general, the results of a reciprocal crossing program form a consistent pattern. Most of the crosses attempted produced an ample seed set. However, crosses involving four populations taken from the ancient lake bed and two populations taken from formerly glaciated areas produced some failures and low seed sets. The latter crossing reactions are also assumed to be indications of developing genetic isolation and incipient speciation.

Chromosome behavior during microsporgenesis was examined in all natural cultures and in some of their artificial hybrids. Most cultures contained 14 chromosomes and displayed normal meiotic segregation. However, irregular segregation of the 13-15 type occurred occasionally in many cultures and did not necessarily correlate with low seed sets. A high incidence (60%) of 13-15 segregation was observed in a culture taken from a peat bog located in the ancient lake bed. This same culture also displayed marked crossing barriers and contained an aneuploid plant (n=13). Another lake bed culture collected in Cache Valley was also aneuploid (n=15). Hybrids of these two lake bed cultures and of a third culture taken on the floor of Salt Lake Valley occasionally exhibited 15 chromosomes at metaphase I of meiosis, an indication that plants in their ancestry may have contained 15 chromosomes. The extra chromosome was probably supernumerary.

During the pluvial period that produced Lake Bonneville M. guttatus was restricted to nonglaciated canyons. The altitudinal range of M. tilingii, a normally alpine plant, was depressed by glacial advances and hybridizations occurred between this species and M. guttatus. Two populations collected on the North Fork of the Provo River appear to be natural hybrids of these species. Following the last withdrawal of Lake Bonneville M. guttatus migrated down the drainages and into the former lake bed where it met and occasionally hybridized with a valley form, M. glabratus,

that had migrated into the lake bed from the south. The three Wasatch front populations that displayed low fertility and extra chromosomes were hybrids of these species. Although they tend to be somewhat infertile, populations of natural hybrids possess genetic diversity by virtue of their varied parentage. Such populations are probable candidates to produce recombination types that will develop into new species. Microfilm $2.75; Xerox $5.20. 103 pages.

STUDIES ON TWO SPECIES OF THE GENUS ARCHANGIUM (MYXOBACTERALES)

(Order No. Mic 61-6811)

James Clifton McDonald, Jr., Ph.D.
University of Missouri, 1960

Supervisor: John E. Peterson

The family Archangiaceae (Myxobacterales, Schizomycetes) consists of the genus Archangium Jahn and the genus Stelangium Jahn. The biology of two species of the genus Archangium, A. gephyra and A. primigenium, was studied. Organisms used in the investigation were isolated from soil and from the bark of living trees.

Pure cultures of both Archangium species were obtained by the quick-transfer method and by the use of antibiotics. Penicillin G at a concentration of 9.75 u/ml. or less was the only antibiotic of nine tested which successfully produced a pure culture of Archangium primigenium. Archangium gephyra pure cultures resulted when varying concentrations of Penicillin G, Gramicidin, and Bacitracin were used. Actidione, an antifungal reagent, was incorporated into all media except those media utilized in nutritional studies.

Basic morphology, some of which was previously reported, was studied, confirmed, and extended. Germination of the fruiting bodies was described as well as fruiting body formation. Vegetative cells were stained with standard bacteriological dyes, aceto-carmine, and Feulgen's Reagent. All cells are Gram-negative and nonacid fast. Morphological irregularities resulting from the use of Penicillin and Actidione were discussed.

The responses of these two organisms to different environmental conditions have been studied. Archangium primigenium and A. gephyra have temperature optima for vegetative growth, fruiting body formation, and fruiting body germination of 30° to 32°C. Archangium gephyra maintained physiological activities at higher temperatures (35° - 40°C.) than A. primigenium; A. primigenium functioned at lower temperatures (15° - 20°C.) better than A. gephyra.

Both species grew best at hydrogen ion concentrations near neutral; both grew at pH 5 and neither would grow above pH 8.5.

Fruiting bodies of both myxobacteria were dried and subjected to a variety of prolonged moisture conditions. A. primigenium fruiting bodies lost viability after 44 days when exposed to 100% relative humidity; fruiting bodies of A. gephyra remained viable twice as long at 100% humidity. Both species lost viability in 44 days on exposure to alternating "0"%-100%-"0"% humidities. At room humidities (average of less than 25%) both species have remained viable over 259 days. At "0"% humidity A. primigenium lost viability four times faster than A. gephyra.

Dried and moist fruiting bodies of both species were subjected to 0.1 and 1N HCl, 1% and 5% NaClO, 1:1000 and 1:100 parts $HgCl_2$ to water, and 50% and 99% isopropyl alcohol. A. gephyra fruiting bodies, especially in the moist state, were slightly more resistant to HCl, 99% alcohol, and NaClO solutions than were those of A. primigenium. Both species were quite sensitive to other toxic chemicals. Weak concentrations of NaClO seemed to be stimulatory to fruiting body germination. A. primigenium fruiting bodies appeared to require desiccation before germination was possible.

Complete vitamin and nucleic acid solutions and casein hydrolysate were tested for growth stimulatory properties. Vitamins and nucleic acids enhanced certain side effects (pigmentation, colony density), but did little to stimulate vegetative cell growth. Casein hydrolysate was extremely effective in enhancing colony growth. A 0.25% addition of casein hydrolysate was stimulatory. Vitamins in concentrations of 0.5 - 1% and casein hydrolysate in 1% concentration were inhibitory.

Polysaccharides were more readily utilized than monosaccharides. These carbon sources were quite stimulatory to growth. Galactose, cellobiose, dextrin, and glycogen were most stimulatory to growth of A. primigenium. Sucrose, galactose, raffinose, dextrin, starch, glycogen, and cellobiose were all stimulatory to growth of A. gephyra.

Nearly-defined synthetic agar media which support growth of both Archangium species have been developed; the constituents of casein hydrolysate are undefined elements. Both species have been grown in liquid culture for the first time.

Microfilm $2.75; Xerox $6.00. 122 pages.

A BLADE TISSUE STUDY OF FORTY-SEVEN SPECIES AND VARIETIES OF ACERACEAE

(Order No. Mic 61-1498)

Harold Oren Powers, Ph.D.
Syracuse University, 1960

Supervisor: Norman J. Gillette

The leaves of 46 species and varieties of Acer and one species of Dipteronia are studied. Primary concern in this report is with the relationships of the various internal tissues of each blade along with their interrelationships for the entire series. Epidermal tissue and spongy mesophyll are considered as structures conducive to horizontal transfer of materials between the veins. Palisade tissue lacking lateral contacts between cells is unable to contribute to this horizontal translocation. Palisade cells then make up the vertical component of the lamina and while adding to the total volume of the blade add nothing to the transfer of materials between veins.

The formula SEE/P was used to determine the relative capacity of non-vascular tissues for horizontal conduction in each leaf. The distances between veins were measured and designated as the intervascular interval, (IVI). To test the validity of the SEE/P ratio as a reliable indicator of

conductive capacity of non-vascular tissues, the coefficient of correlation was determined between IVI and SEE/P. The correlation between these two values was found to be 0.6837. Therefore it can be concluded that the greater the relative proportions of spongy mesophyll and epidermal tissue in a leaf blade, the greater the distance between veins. Correlations were determined between the inter-vascular intervals and the proportions of spongy tissue to palisade; IVI and bundle sheath extension intervals; IVI and blade thickness; IVI and vein length; IVI and bundle sheath extension intervals; vein length and bundle sheath extension intervals; SEE/P and bundle sheath extension intervals; and finally, dermal and blade thickness. Significant correlations were found to exist between all except IVI and blade thickness. The low correlation in the latter case indicates little relationship between the thickness of the leaf and the distance between veins. Values for IVI are the best indications of the conductive capacity of the non-vascular tissues.

The percentage of total blade thickness was calculated for each of the three tissues making up the leaf volume. Standard deviations of the percentages were calculated to determine constancy of each throughout the series. Dermal tissue was the most constant of the three types with a standard deviation of 4.06. Palisade tissue and spongy mesophyll had standard deviations of 4.30 and 4.87 respectively. This means that throughout the series each of the three tissues occupied relatively constant proportions of the blade thickness. Thickness of leaf blades were unrelated to the area of the blade, which varied considerably. A. macrophyllum had the largest area with 263 square centimeters while the smallest area was found for the leaf of A. monospessulanum.

Stomata were of the ranunculaceous type found only in the lower epidermis. Epidermal cells were found to have three different shapes with no relation between shapes of upper and lower epidermal cells. Upper epidermal cells of some species have a peculiar type of internal doubling. This phenomenon is described and the species listed which were found to possess these cells.

Vascularization patterns were of four general types which are described with the frequency of occurrence. The veins of D. sinensis were found to possess very large secretory sacs located in the veins. Veins of most species have not only parenchymatous tissue as sheaths but also sclerenchymatous tissue which may act as the bundle sheath extension. Bundle sheath extensions were found to be associated with 56.5% of the total vein length of the series. Only one species lacked bundle sheath extensions on the lesser veins. Microfilm $2.75; Xerox $3.00. 57 pages.

CHEMISTRY, ANALYTICAL

THERMOCHEMICAL PRECIPITATION TITRIMETRY AND PRECIPITATION THERMODYNAMICS IN AQUEOUS SOLUTIONS AND MOLTEN SALTS

(Order No. Mic 61-2355)

Edward John Billingham, Jr., Ph.D.
The Pennsylvania State University, 1961

With the aid of automatic semiconductor instrumentation thermometric precipitation titrations have been investigated. Studies were carried out in aqueous solutions and in fused salts, in a range of temperatures between 25° C. and 350° C. The thermodynamics of ionic precipitation reactions have been studied and interpreted in terms of reasonable mechanisms. Kinetic masking has been successfully applied to elimination of interferences in qualitative precipitation titrimetry. A hole model of liquid structure has been proposed to account for the remarkable properties of fused salt solvents. The foundation of volumetric analysis in molten salts has been developed.

In aqueous solution at 25° C. the precipitation of calcium with oxalate yielded a well defined thermometric titration curve corresponding to instantaneous attainment of equilibrium. In contradistinction, upon titration of magnesium with oxalate an isothermal curve was obtained, due to a delayed precipitation mechanism involving a complex intermediate. Based on these differences in behavior a method, applicable to limestone and dolomite analysis, has been devised for the non-separative determination of calcium in the presence of magnesium by automatic titration with standard oxalate. The heat of precipitation of calcium oxalate was found to be -6.1 kcal/mole. The corresponding entropy change was zero which is accounted for by the extensive hydration of the calcium.

The precipitation of silver chloride, silver bromide, silver iodide, silver chromate, and lead chromate was studied in fused alkali nitrate solvents. Thermometric titration curves were recorded in an adiabatic titration cell, in which random temperature fluctuations were minimized to ± 0.001° C. Using a remotely controlled automatic buret, methods have been developed for the argentimetric titration of halides in molten salts. A precision and accuracy of 2% were attained in concentrations between 0.001 and 0.05 molal. Chromate ion was found to be involved in the associative equilibrium $XCrO_4^{=} \rightleftharpoons (CrO_4)_x^{2x-}$. The silver halides precipitated from fused salt solvents as crystalline solid phases, corresponding to the usual 1:1 stoichiometry prevailing in water. The precipitation of AgCl, AgBr, and AgI was exothermic yielding well defined thermometric titration curves from which heats of reaction, free energies, and entropies were computed. The entropy of precipitation of silver chloride exhibited remarkable invariance in the various solvent melts and at all temperatures between 150° C. and 350° C. In contradistinction, entropy changes corresponding to the precipitation of AgBr and AgI varied extensively as a function of solvent (fused sodium, potassium, lithium nitrate and eutectic mixture thereof) and temperature. This behavior is accounted for by the combined effect of two factors, viz.:

a. The selective mobility of silver ion at elevated temperatures in crystals of silver bromide and silver iodide.

b. The properties inherent in the liquid structure of the fused salt solvents used in this study.

A model is proposed in which the molten salt is visualized as consisting of closely packed lattice units. Inter-lattice vacua amount to less than 2% of the molar volume. Eighty percent of the lattice positions are occupied by anions or cations, and 20% are vacant "holes." Electroneutrality is maintained throughout the crystal, solute cations and anions occupying corresponding cationic and anionic vacancies.

Microfilm $2.75; Xerox $5.80. 116 pages.

ACID-BASE EQUILIBRIA IN ACETONITRILE

(Order No. Mic 61-2136)

Miran Kevork Chantooni, Jr., Ph.D.
University of Minnesota, 1961

Acid-base properties were studied in acetonitrile as solvent by determining the extent of dissociation of fresh solutions of acids conductimetrically and with color indicators. Potentiometric measurements with the hydrogen electrode, and to a certain extent, with the glass electrode, were unsuccessful.

It was found that acetonitrile differentiates acids that are strong in water. Perchloric acid was found conductimetrically to be completely dissociated in acetonitrile. The following acids were found to be weak, in order of decreasing acid strength: $HBr > H_2SO_4 > HNO_3 > HCl > HPi$.

In freshly prepared pure solutions, the log(equivalent conductance) vs $\log c_{HA}$ plots of the weak acids mentioned above indicate simple acid dissociation

$$HA \rightleftharpoons H^+_{solvated} + A^- \qquad (1)$$

in solutions more dilute than 10^{-2} M, while in more concentrated solutions the acid anion is associated with undissociated acid

$$2HA \rightleftharpoons H^+_{solvated} + HA.A^- \qquad (2)$$

The ratio of acidic to basic forms of the uncharged indicator base(indicator ratio) of o-nitro p-chloroaniline is proportional to the equilibrium acid concentration of the weak acids mentioned above in solutions 10^{-3} to 10^{-1} M. This is ascribed to acid anion association in reaction (2)

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

accompanied by simple protonation of the indicator base

$$In + H^+_{solvated} \rightleftharpoons HIn^+ \quad (3)$$

The dependence of the indicator ratio upon ionic strength, agreement between conductimetrically and colorimetrically determined dissociation constants, and the decrease in indicator ratio upon aging in sulfuric acid solutions substantiate the equilibria described by reactions (2) and (3), thus refuting direct reaction of indicator base with undissociated acid

$$HA + In \rightleftharpoons HIn^+ \cdot A^-$$

The reaction of o-nitroaniline with H_2SO_4 in H_2SO_4 - Et_4NHSO_4 buffers in AN was interpreted on the basis of $H_2SO_4 \cdot HSO_4^-$ formation.

The decrease in acidity with time, and attainment of constant acidity in both $HClO_4$ and weak acid solutions from indicator measurements and the increase in conductance with time and the attainment of constant conductance in weak acid solutions are ascribed to slow transformation of the solvated proton HS^+ to a proton associated to a stronger basic form of the solvent, HS_b^+, and equilibration between these two proton forms. The conductance of $HClO_4$ solutions did not change appreciably upon aging, because of similar mobilities of HS^+ and HS_b^+.

The ratio of indicator ratios of o-nitro p-chloroaniline in fresh and aged $HClO_4$ solutions of the same concentration was 70 ± 10 and in H_2SO_4 solutions 7.5 ± 0.5. The ratio of conductance in fresh and aged H_2SO_4 solutions was 8.0 ± 0.5. The ratio of indicator ratios (and conductance) in H_2SO_4 approaches the square root of that in $HClO_4$ solutions, interpreted as simple weak acid dissociation and/or $HA.A^-$ formation and equilibration between HS^+ and HS_b^+.

The proton forms, HS^+ and HS_b^+, in $HClO_4$ solutions were characterized and distinguished as follows:

1) The polarographic wave in fresh solutions with $E_{1/2}$ of -0.70 v. vs S.C.E. is displaced and $(E_{1/2})_{aged}$ becomes -1.20 v. vs S.C.E. upon extensive aging.

2) A band at 795 cm^{-1} in the infrared spectrum is replaced by one at 1720 cm^{-1}.

3) Due to the greater basicity of HS_b^+, two breaks in the potentiometric (glass electrode -S.C.E.) and colorimetric (using o-nitro p-chloroaniline as indicator) titration curves using diphenylguanidine as titrant, were observed when both proton forms were present. The titration was also performed amperometrically at the D.M.E. at -0.8 and -1.3 v. vs S.C.E.

Since each proton form is titrated separately, the reaction

$$HS_b^+ \rightleftharpoons HS^+$$

must be slow. Also, the reversion of S_b to S apparently is slow. A .010M solution of aged $HClO_4$ was exactly neutralized with diphenylguanidine, liberating an amount of S_b equal to HS_b^+ (ca. analytical acid concentration) in the aged solution prior to neutralization. The neutralized

$$HS_b^+ + B \rightleftharpoons S_b + Bh^+ \quad \text{(where B = base)}$$

mixture was allowed to stand for 38 hours, then titrated with fresh $HClO_4$, using o-nitro p-chloroaniline as indicator

$$S_b + HS^+ \rightleftharpoons HS_b^+ + S$$

Since HS_b^+ does not protonate the indicator base appreciably and HS^+ does, the concentration of S_b in the neutralized solution was determined, and found to be the same as in the solution immediately after neutralization.

Microfilm $3.80; Xerox $13.30. 293 pages.

A STUDY OF THE SEPARATION OF PHOSPHORUS ACIDS

(Order No. Mic 61-2187)

Fredi Jakob, Ph.D.
Rutgers University, 1961

Major Professor: Wm. Rieman III

The separation of nine-component mixtures of phosphorus acids has been achieved by salting-out chromatography on a special resin of low capacity. The mean recoveries in three such separations were 98, 103 and 99%. Shorter columns of the same resin were used for the separation of the following groups of phosphorus acids: $MePO(OH)_2$ from $EtPO(OH)_2$, $PrPO(OH)_2$ from $EtPO(OH)_2$, $MePO(OH)_2$ from $BuPO(OH)_2$, and $EtPO(OH)_2$ from $BuPO(OH)_2$.

Mixtures consisting of H_3PO_4, $MePO(OH)_2$ and $EtPO(OH)_2$, or H_3PO_4, $MePO(OH)_2$ and $BuPO(OH)_2$ were separated into two fractions. In both cases the first fraction contained all of the $MePO(OH)_2$ and H_3PO_4. In the first of the aforementioned cases, the second fraction contained all of the $EtPO(OH)_2$. In the latter case, the second fraction contained all of the $BuPO(OH)_2$.

A method for the determination of $MePO(OH)_2$ and H_3PO_4 in the presence of lithium chloride has been developed. This method was also applicable to the determination of MePO(OH)OMe and $HOPO(OMe)_2$ in the presence of lithium chloride.

An evaporation technique was developed for the removal of hydrochloric acid and water from solutions of phosphonate esters. Quantitative recoveries of the esters were obtained.

A study of the recovery of phosphonate esters from lithium chloride was conducted. Precipitation, solvent-extraction, and gathering techniques were not completely successful. A method of separation of PrPO(OH)OEt from lithium chloride by ion exclusion has been developed. Quantitative separation of EtPO(OH)OMe from lithium chloride in a solution of pH 2.0 has been achieved by adsorption on cellulose columns impregnated with zirconia.

A micro-titration method has been developed for the determination of several thousandths of a millimole of an alkane phosphonic acid in the presence of several millimoles of hydrochloric acid. This titration method was used to study the extent of hydrolysis of several phosphonate esters in boiling 6M hydrochloric acid.

The rate of hydrolysis generally increased with decreasing size of the P-alkyl group and increasing size of the O-alkyl group. The methyl ester of butane phosphonic acid did not follow this general trend.

Microfilm $2.75; Xerox $5.60. 114 pages.

A SPECTROPHOTOMETRIC DETERMINATION OF RHODIUM WITH s-DIPHENYLCARBAZONE. COMPLEXES OF RHODIUM, TIN, AND CHLORIDE.

(Order No. Mic 61-1388)

Fred Lowery Johnson, Jr., Ph.D.
The University of Texas, 1959

Supervisor: Dr. Gilbert H. Ayres

Part I

Many possible color-forming organic reagents were tested with rhodium, and, of the few producing colors, "s-diphenylcarbazone" was chosen as most suitable. Using this reagent, a very sensitive spectrophotometric method for determining rhodium was developed. The maximum range for use in a 1 cm. cell is from 0.04 parts per million (absorbance 0.025) to 3 parts per million (absorbance 1.8), with the optimum range from 0.3 to 1.3 parts per million. The molar absorptivity of rhodium in the method is 6.18×10^4. Iridium gives the most serious interference among the platinum metals due to the low pH at which it precipitates. Palladium, platinum, and gold can be present in quantities 1.5, 2.5, and 3 times that of rhodium, respectively, while osmium and ruthenium are completely volatilized in the procedure used and cause no interference. Spectrophotometric studies indicate a reaction ratio of 2:1 (reagent to rhodium), and observed properties point to a chelate structure, but the exact composition and structure of the purple complex remain obscure.

Part II

The complexes which form between rhodium, tin(II), and chloride were studied by means of spectrophotometry, polarography, ion exchange, extraction with amyl acetate, and precipitation with tetraphenylarsonium chloride. Results obtained indicate that the complexes are very unstable in the absence of large excesses of common ions and that a large number of complexes are present but in labile equilibrium. Absorbance maxima occur between 420 and 480 mμ, and a given sample will shift both in the position of and in the height of the maximum upon dilution or upon aging. No evidence was found for reduction of rhodium(III) when complexation occurs, and no data were obtained indicating the composition of the complexes.

Microfilm $2.75; Xerox $4.60. 87 pages.

A STUDY OF THE POLAROGRAPHY AND VISIBLE SPECTRA OF A SERIES OF COPPER CHELATES OF 1,3-DIKETONES.

(Order No. Mic 61-1974)

Harold David Russell, Ph.D.
The University of Nebraska, 1961

Adviser: Henry F. Holtzclaw, Jr.

A study of the irreversible polarographic reductions and visible absorption spectra of a related series of copper chelates of 1,3-diketones was made in aqueous 75% dioxane. This series was composed of fifteen chelates with all possible substitutions at the one and three positions of 1,3-propanedione by the groups: methyl, trifluoromethyl, phenyl, 2-thienyl, and 2-furyl. Eight of the 1,3-diketones (2-thenoylacetone, 2-furoylacetone, benzoyltrifluoroacetone, benzoyl-2-thenoylmethane, benzoyl-2-furoylmethane, di-2-thenoylmethane, 2-thenoyl-2-furoylmethane, and di-2-furoylmethane) were prepared by a general Claisen condensation method in which a methyl ketone is condensed with an ethyl ester in the presence of a basic condensing agent. The other seven 1,3-diketones (acetylacetone, trifluoroacetylacetone, benzoylacetone, hexafluoroacetylacetone, 2-thenoyltrifluoroacetone, 2-furoyltrifluoroacetone, and dibenzoylmethane) were commercially available. The chelates of the ligands were subsequently prepared by conventional methods.

Roseaniline hydrochloride was found to be a maximum suppressor which effectively eliminated the maxima present on the rising portion of the polarographic waves for all thirteen of the chelates which exhibited maxima of this type. The suppressor was shown not to interfere with the reduction of the chelates.

Relative orders of stability for the copper chelates were established on the basis of the polarographic half-wave reduction potentials and the frequency of maximum visible absorption. The more stable chelates were reduced at the more negative half-wave potentials and were found to have a larger frequency of maximum absorption. These orders were compared with each other and with the relative order of stabilities as determined by log $K_{f_1}K_{f_2}$ measured potentiometrically in aqueous 75% dioxane by Van Uitert (L. G. Van Uitert, Ph.D. Thesis, Pennsylvania State College, June, 1952).

The three relative orders of stability generally agreed within the experimental errors of the measurements, except for the copper chelates of acetylacetone, benzoylacetone, and dibenzoylmethane. For these chelates, the orders as determined by the half-wave potentials and the frequencies of maximum absorption were opposite from the order determined by log $K_{f_1}K_{f_2}$. Possible errors for the trend deviation in these three chelates were discussed.

Microfilm $2.75; Xerox $3.00. 54 pages.

PART ONE: SORPTION OF PHENOL BY LOW-CAPACITY ION-EXCHANGE RESINS. PART TWO: AN ANALYTICAL AND KINETIC STUDY OF A CHELATING RESIN.

(Order No. Mic 61-2195)

Richard Sanford Turse, Ph.D.
Rutgers University, 1961

Major Professor: William Rieman III

PART ONE

Since low-capacity ion-exchange resins were found to sorb organic solutes to a greater extent than the normal-capacity exchangers, a study was undertaken to see if these low-capacity resins would be of much use in sorbing phenol from aqueous systems. It was found (1) that the

anion exchangers were better sorbers of phenol than the cation exchangers, (2) that, as the capacity of the anion exchangers decreased within the range studied, 1.16 to 3.40 meq. per g., the sorptive ability for phenol increased, (3) that, as the capacity of the cation exchangers decreased, the sorptive ability increased to a maximum, after which it decreased with further decreases in capacity, and (4) that no simple isotherm was followed.

PART TWO

Elution chromatography and displacement chromatography of several metal ions through a chelating resin, Dowex A-1, containing a methyliminodiacetate group as the functional group, were attempted with various eluents. In the cases where complete elutions were achieved, severe spreading of the elution graphs was noted. In other cases, the metal ion could not be removed from the resin. In the displacements, no successful separation of various mixtures of ions could be achieved due to spreading of the graphs. It was concluded that slow kinetics caused these poor elutions and, therefore, a kinetic study of various metal exchanges with this resin was undertaken.

Although it has been shown in the literature that the rate-determining step in the exchanges involving normal ion-exchange resins is diffusion, through either the particle or the thin film surrounding the particle, all the following points tend to support the conclusion that chemical reaction is the rate-controlling step in the case of this chelating resin. (1) The plots of the data were more nearly linear when derived from the chemical-rate equation than when derived from the diffusion equation. (2) The experimental points lie much closer to the theoretical line of the plot of amount reacted vs. time, based upon chemical reaction, than the theoretical line of the same plot based on diffusion. (3) Resin size had no effect on the calculated chemical-rate constant while it caused the apparent diffusion coefficient based on diffusion to vary considerably in the same exchange. This phenomenon is impossible for diffusion-controlled kinetics. (4) There were very many unlikely diffusion coefficients calculated for the different reactions when one assumed that the reaction was diffusion-controlled. (5) Many points from the literature indicate that chemical kinetics would not be surprising in exchanges involving the breaking of a covalent bond.

Several rate constants were calculated and tabulated but they show no correlation to the stabilities of the chelates formed.

Dilute solutions of copper ion, 1 ppm., in 1M ammonium chloride were concentrated by use of this chelating resin. Recoveries of 99% by elution with 1M hydrochloric acid were obtained with a bed volume of only 1.1 ml. and a flow rate of 3.8 cm. per min. Faster flow rates caused some loss. Microfilm $2.75; Xerox $6.80. 142 pages.

CHEMISTRY, BIOLOGICAL

THE EFFECT OF ALTERED ENDOCRINE STATES ON THE PROPERTIES OF HEPATIC GLUTAMIC-PYRUVIC TRANSAMINASE

(Order No. Mic 61-1858)

Diana Scott Beattie, Ph.D.
University of Pittsburgh, 1961

The well-characterized physiological and metabolic changes evoked by various hormonal states are usually considered to represent the end result of a number of biochemical reactions, any one of which might be affected by the hormone. A change in the metabolic environment, such as hormone administration, alters drastically the activity of many specific enzymes, although little is known regarding the mechanisms by which these changes are brought about.

In the present study, the effect of altered endocrine states on the activity of hepatic glutamic-pyruvic transaminase (GPT) in the crude state was investigated. Normal animals and animals receiving cortisone were used as a source of liver for a partial purification of the enzyme to establish whether the cortisone-treated animals manifested greater enzymatic activity on the basis of an increase in the amount of catalytically active enzyme protein present or on the basis of a qualitative change in the properties of the enzyme.

Rats treated with pharmacological doses of cortisone-acetate daily for five days showed a 6-fold increase in hepatic GPT activity, calculated per gram of liver or per mg. of liver protein. Two days of treatment with the corticoid doubled the enzymatic activity, but the maximum level of activity was not reached until the fifth day of hormone administration. Adrenalectomy decreased the enzymatic activity below that found in control rats. Testosterone did not affect the enzymatic activity and did not counteract the stimulation by cortisone. In alloxan-diabetic rats, the activity of the enzyme was increased to a level equivalent to that observed in the experiments with cortisone. Treatment of the diabetic animals with insulin restored the activity to the control level. The GPT activity of the adrenalectomized diabetic rat was decreased below that of control animals the same weight.

Ethionine, the ethyl analogue of methionine, when administered in the diet or by injection, did not alter the GPT activity; however, it inhibited significantly the large increase in enzymatic activity induced by cortisone. These results provide indirect evidence to support the view that cortisone acts by promoting synthesis of new enzyme.

A 40-fold purification of GPT from livers of normal and cortisone-treated rats was effected by heat denaturation, ammonium sulfate fractionation and column chromatography on hydroxyl apatite. Analysis by ultracentrifugation and electrophoresis indicated that the enzyme was still inhomogeneous. The absorption spectrum of the purified enzyme has a pronounced shoulder at 410 mμ.

Michaelis constants for alanine and α-ketoglutarate were evaluated as 1.5×10^{-2} M and 1.8×10^{-4} M and were identical for the enzyme from the two sources. A competitive inhibition by glutamate, α-aminobutyric acid and isonicotinic acid hydrazide was observed in both enzymes with identical values of K_1 in each case. The purified enzymes were insensitive to EDTA and Mg^{+2} ions, but were

strongly inhibited by sulfhydryl reagents. The energy of activation of the purified enzymes was 16,000 calories. The enzymes had maximum activity at pH 8.0 which was due to an effect on V_m and not on K_m or the enzyme stability. The enzyme was specific for alanine as amino acid substrate, although a valine transaminase was apparently present with GPT. The amount of pyridoxine per mg. of protein, as determined by microbiological assay, was 2.5 times greater in the enzyme purified from cortisone-treated rats than in that from normal rats. These results suggest that corticoids do not increase GPT activity by affecting its kinetic or thermodynamic properties nor by changing its sensitivity to metal ions, inhibitors and hydrogen ion concentration.

Microfilm $2.75; Xerox $5.40. 108 pages.

THE BIOSYNTHESIS OF THE CORRIN MOIETY OF VITAMIN B_{12} FROM METHIONINE AND δ-AMINOLEVULINIC ACID

(Order No. Mic 61-1396)

Richard Connell Bray, Ph.D.
Columbia University, 1961

Vitamin B_{12} contains a structure similar to the porphyrins, and evidence exists that it has a similar biogenetic origin; but there are six "extra" methyl groups which cannot arise from the known precursor of porphyrins, δ-aminolevulinic acid (ALA). In order to investigate the biosynthesis of these methyl groups, cultures of a B_{12}-producing actinomycete (ATCC 11072) were grown in the presence of known methyl donors labeled in the methyl groups with C^{14}, and the synthesized B_{12} was isolated after addition of carrier. Methionine-Me-C^{14} labeled the B_{12} strongly, whereas betaine and choline-Me-C^{14} did not. A larger amount of B_{12} labeled by methionine-Me-C^{14} was then prepared and after dilution degradations were performed to locate some of the labeled carbon atoms. The nucleotide fragment was not labeled; all of the radioactivity was in the corrin moiety. From the latter an oxidation product, 3,3-dimethyl-2,5-dioxpyrrolidine-4-propionic acid, representing ring C was obtained. This compound was also synthesized for carrier purposes. It contains one of the six "extra" methyl groups, and it was found to have 1/6 of the specific activity of the B_{12}. Further degradation of this compound showed that the radioactivity was entirely in one, or possibly both, of the gem-methyl groups. A Kuhn-Roth oxidation of the whole corrin moiety yielded acetic acid labeled only in the methyl group and having roughly 1/6 the specific activity of the B_{12}. It was supposed that one of the methyl groups on ring C was derived from a methylene carbon of ALA via decarboxylation of an acetic acid side chain. In order to test this hypothesis the bacteria were grown in the presence of ALA-2,3-C^{14}, and the radioactive B_{12} so obtained was degraded to ring C. Ring C contained 1/4 of the radioactivity of the B_{12}, in agreement with expectation if ALA is utilized for the entire porphyrin-like structure aside from the methyl groups. Kuhn-Roth oxidation of ring C in this case yielded labeled acetic acid in which the carboxyl group was approximately twice as radioactive as the methyl group.... as expected if one labeled methyl group were diluted in the reaction by a chemically indistinguishable one derived from another source. In addition, B_{12} was produced incorporating ALA-5-C^{14}, and an over-all Kuhn-Roth oxidation of it yielded some radioactivity in methyl carbon. This is evidence that the methyl group on the α-position of ring A in B_{12} is homologous with the normal bridge carbon, here bypassed in favor of a direct link between the rings.

The experiments taken together confirm that ALA is the biosynthetic precursor of the corrin moiety of vitamin B_{12} as it is of porphyrins, and indicate that the methyl group of methionine is a precursor of all of the six "extra" methyl groups. It is suggested, in agreement with an earlier hypothesis of Bonnett, that the methyl groups may be attached by a process of direct C-alkylation.

Microfilm $2.75; Xerox $4.00. 73 pages.

GLUCOSE UTILIZATION BY RAT LIVER

(Order No. Mic 61-1507)

David Louis Di Pietro, Ph.D.
Temple University, 1961

The catabolism of carbon-14-labeled glucose, fructose and glucose 6-phosphate was studied in rat liver slices and homogenates. In these preparations it was found that the oxidation of glucose was dependent upon the glucose concentration in the medium up to at least 0.1 M. In liver slices the amount of glucose converted to CO_2 at a concentration of 0.01 M was about 10-fold higher than the amount oxidized at a concentration of 0.001 M; raising the glucose concentration from 0.01 to 0.1 M resulted in a further (5-fold) increase in the oxidation rate of this sugar. This extreme concentration dependence was also observed in homogenates, as well as with slices and homogenates prepared from livers of fasting rats. The oxidation rate of glucose carbon-1 was considerately higher than carbon-6, but a constant ratio of carbon-1/carbon-6 oxidation was maintained regardless of the glucose concentration of the medium.

Under identical experimental conditions maximum fructose oxidation was observed at fructose concentrations of 0.01 M or lower, and the oxidation rate of this sugar was 70% of maximal at 0.002 M. The capacity for glucose oxidation approached that of fructose oxidation only at very high glucose levels or in homogenates fortified with yeast hexokinase.

Glucose 6-phosphate-C^{14} was oxidized rapidly by liver homogenates even when present at very low concentrations, contrasting with the low rate of oxidation of glucose under these conditions. As with glucose, however, carbon-1 of glucose 6-phosphate was oxidized preferentially to carbon-6. These observations, as well as data on the rate of glycolysis of various intermediates of the Embden-Meyerhof pathway by liver homogenates have suggested that glucose utilization in these preparations is limited in part at least by the hexokinase (glucokinase) reaction. An alternative pathway for glucose utilization was sought in the glucose dehydrogenase reaction, particularly in view of the reportedly high Michaelis constant of this enzyme for glucose. However, the standard assay procedures failed to reveal any trace of glucose dehydrogenase activity in

rat liver, although under the same conditions considerable activity was observed in a beef liver extract.

A direct assay for rat liver glucokinase was undertaken using an extract from which glucose 6-phosphatase activity had been removed by ultracentrifugation. The method involves the coupling of glucokinase with an exogenous source of glucose 6-phosphate dehydrogenase and measurement of TPN^+ reduction spectrophotometrically. The activity of this soluble glucokinase was found to be sufficiently high to account for previous estimates of glucose phosphorylation in liver slices and for the high rate of glycogen synthesis in the intact rat. Fasting or alloxan diabetes caused a lowering of hepatic glucokinase activity on a per g. liver basis to about 40% of the value for normal, fed rats.

Liver glucokinase requires ATP and Mg^{++} for activation; Mn^{++} also activates the enzyme but to a lesser extent. The requirement for ATP by liver glucokinase cannot be satisfied by uridine triphosphate, inosine triphosphate or guanosine triphosphate. An apparent Michaelis constant of 4×10^{-4} M for ATP was calculated for the glucokinase in the experimental system. The apparent Michaelis constant for glucose was on the order of 0.004 M and maximum rates were observed at a glucose concentration of about 0.05 M. This relatively low affinity for glucose by liver glucokinase contrasts sharply with the low Michaelis constants reported for other hexokinases, and provides the basis for a possible regulating mechanism for the utilization of glucose by the liver of the intact rat. It is suggested that the rate of glucose phosphorylation and glycogen synthesis by rat liver is dependent upon the blood sugar level by virtue of the characteristic affinity of hepatic glucokinase for its substrate.

Microfilm $2.75; Xerox $6.80. 143 pages.

I. THE PARTIAL PURIFICATION AND PROPERTIES OF A GERMINATION INHIBITOR(S) ISOLATED FROM APPLE SEED. II. PYRIMIDINE METABOLISM IN GERMINATING SEEDLINGS.

(Order No. Mic 61-2470)

William Rue Evans, Ph.D.
Purdue University, 1961

Major Professor: Dr. Bernard Axelrod

I. THE PARTIAL PURIFICATION AND PROPERTIES OF A GERMINATION INHIBITOR(S) ISOLATED FROM APPLE SEED

As part of an inquiry into the biochemical events associated with germination and dormancy, the nature of a germination inhibitor reported to be present in dormant apple seed was investigated. Previous investigators had indicated that aqueous extracts of dormant apple seed not only inhibited seed germination but also inhibited proteolysis. Extensive attempts to demonstrate the presence of the proteinase inhibitor failed, but the inhibition of seed germination by these extracts of dormant apple seed was readily reproduced.

Experiments were then directed towards a characterization of the compound(s) responsible for this inhibition. A fractionation scheme was evolved which employed ion exchange resins, liquid-liquid extraction with ether, and paper chromatography indicated the presence of at least two acidic substances capable of inhibiting the germination of rape seed.

Other experiments showed that extracts of non-dormant apple seed were also capable of inhibiting seed germination. Further studies on several enzymes revealed that no causal relationship could be established between enzymic inhibition and inhibition of seed germination by these extracts in the enzymes studied.

II. PYRIMIDINE METABOLISM IN GERMINATING SEEDLINGS

In a separate phase of the study of the biochemical events associated with germination and dormancy, an attempt was made to assess the turnover or new production of ribonucleic acid and deoxyrebonucleic acid in germinating rape seed. The use of uracil and thymine labeled in 2-position with C^{14} has disclosed that at least in the early stages of germination these two pyrimidines are only sparingly incorporated into nucleic acid but rather are rapidly decomposed by a sequence of events suggestive of that found in higher animals and some bacteria.

Thus when rape seed was germinated in solutions of either uracil-2-C^{14} or thymine-2-C^{14} over 90% of the original radioactivity present in the germination vessel had been metabolized to $C^{14}O_2$ in 72 hours of germination. Further data also indicated that the capacity of the seedling to degrade these pyrimidines increases with increasing age of the seedling.

Identification of the radioactive intermediates was accomplished by co-chromatography with the known degradative products of uracil and thymine. Among the catabolic products shown to arise from these bases in addition to CO_2, were dihydrouracil and β-ureidopropionic acid from uracil, and dihydrothymine and β-ureidoisobutyric acid from thymine. The formation of labeled β-alanine or β-aminoisobutyric acid could not be demonstrated owing to the loss of the C^{14}-labeled C-2 atom as CO_2. However, by analogy to the established catabolic pathway of uracil and thymine metabolism in animals and some bacteria, the demonstration of this pathway in rape seed could account for the presence of β-alanine and β-aminoisobutyrate in plants.

Incorporation of these bases into the nucleic acid of the seedling did occur but clearly the major metabolic pathway was catabolic in nature. After 72 hours of germination in thymine-2-C^{14} only 10% of the radioactivity present in the seedling could be accounted for as nucleic acid, while seeds germinated for 72 hours in uracil-2-C^{14} showed that 40% of the radioactivity in the seedling was present in the nucleic acid fraction. Paper chromatography of the nucleic acid hydrolyzates of seeds germinated in radioactive uracil showed the presence of both uracil and cytosine.

Microfilm $2.75; Xerox $3.80. 68 pages.

THE INFLUENCE OF ALPHA METHYL GLUCOSIDE ON INVERTASE ACTION

(Order No. Mic 61-2211)

Benjamin Freeman, Ph.D.
Columbia University, 1961

One of the most effective retardants of the action of the enzyme, invertase, is alpha methyl glucoside. A study was made of the way this retardation exerts its effect on three important factors at work during the hydrolysis of the substrate, sucrose, by invertase. These factors are concentration of sucrose, concentration of hydrogen-ion, and the accumulation of the product of hydrolysis – invert sugar.

If a normal hydrolysis of sucrose by invertase from brewers' yeast is followed, a characteristic curve is obtained relating the per cent hydrolyzed to the time of hydrolysis. But when alpha methyl glucoside is added to the solution, not only is the hydrolysis slowed down but the very course of the hydrolysis is altered, as shown by a new hydrolysis curve of very different shape.

It was found that alpha methyl glucoside has no effect on the relationship between hydrogen-ion concentration and rate of hydrolysis. It does, however, change the influence of the other two factors.

During a normal hydrolysis the invert sugar that is constantly being formed retards the action of invertase. But in the presence of alpha methyl glucoside the retarding effect of the invert sugar is greatly reduced. During approximately the first half of the hydrolysis the invert sugar shows hardly any retardation of invertase action; its effect is apparent during the latter part of the hydrolysis when the amount of invert sugar accumulates.

It has been shown that the rate of mutarotation of invert sugar is not affected by alpha methyl glucoside.

The relationship between sucrose concentration and rate of hydrolysis is represented, for a normal reaction, by a characteristic curve. But when alpha methyl glucoside is present, the shape of the curve is markedly altered. It shows that with increasing concentration of the glucoside the curve tends to flatten out, and with a concentration of 10 per cent alpha methyl glucoside, the rate of hydrolysis is independent of the sucrose concentration.

Microfilm $2.75; Xerox $3.00. 38 pages.

THE SULFUR DISTRIBUTION OF PAPAIN AND RELATED STUDIES

(Order No. Mic 61-1134)

Alexander Namiot Glazer, Ph.D.
University of Utah, 1961

Chairman: Dr. Emil L. Smith

Inasmuch as papain is a sulfhydryl enzyme, the form in which the sulfur is present in papain is of the greatest interest. Data obtained prior to the present investigation seemed to indicate the presence of six cysteine residues and two sulfur atoms in another form per mole of enzyme.

Early experiments in this investigation failed to confirm the above results. Spectrophotometric determinations with p-mercuribenzoate and N-ethylmaleimide, and argentimetric amperometric titrations, indicated only a trace of sulfhydryl in native, unactivated papain, and only 0.6-1.0 sulfhydryl group per mole of the active enzyme. Denaturation did not increase the sulfhydryl titer.

In view of these findings an attempt was made to find a method which would give an unequivocal answer as to the number of half-cystine and cysteine residues in papain. The disulfide interchange reaction in concentrated acid solution was investigated in the hope that it would prove to be possible to use it for this purpose. Indeed, a method was developed which provided the means of estimating accurately the half-cystine plus cysteine content of proteins. Application of this method to papain indicated the presence of eight groups capable of participating in the interchange. However, cysteine could not be distinguished from cystine by this method. This problem was overcome by means of argentimetric amperometric titration in the presence and absence of sulfite. The titrations indicated the presence of three disulfide bonds in native, unactivated, papain, as well as in papain which had been denatured by urea or sodium lauryl sulfate at near-neutral pH. Exposure to pH 1.7 followed by titration in 8M urea at near-neutral pH, gave a value of four disulfide bonds per mole of papain. These results strongly suggested the presence of eight half-cystine residues in papain.

Chemical confirmation of the above results was obtained by amino acid analysis of acid hydrolysates of performic acid-oxidized papain. Papain was found to contain 7.7 ± 0.1 moles of cysteic acid per mole of protein.

It had been alleged by several investigators that papain could be inhibited by diisopropylfluorophosphate. The effect of diisopropylfluorophosphate on papain was examined under a variety of conditions but no evidence of inhibition could be detected.

It has been suggested that all the available information on the mechanism of action of papain was consistent with the postulate of a thiol ester as the reactive grouping in the active site of this enzyme. Evidence for the presence of a thiol ester was sought by the technique of ultraviolet difference spectroscopy. The results obtained were inconclusive. In the course of this investigation, it was observed that protein denaturation was associated with the appearance of a peak in the difference spectrum at 230-235 mμ. On the basis of studies of difference spectra of a number of amino acids and proteins, and of poly-L-glutamic acid, it was possible to conclude that the observed peak is the result of both changes in back-bone conformation of the protein and changes in tyrosine and tryptophan spectra occurring on denaturation.

An investigation of the phenolic hydroxyl ionization in papain was also carried out. The tyrosine/tryptophan ratio was determined spectrophotometrically and found to be 3.25:1. This ratio is in excellent agreement with the value of 17 tyrosine residues and 5 tryptophan residues determined by amino acid analysis.

Microfilm $2.75; Xerox $7.00. 148 pages.

STUDIES ON THE PROTEOLYTIC ENZYME SYSTEM OF SKIN AND ITS RELATIONSHIP TO A STATE OF HYPERSENSITIVITY

(Order No. Mic 61-1866)

Julius Golubow, Ph.D.
University of Pittsburgh, 1961

The purpose of the studies presented in this dissertation were twofold: (1), to extend the knowledge of the proteolytic enzyme system of skin, in particular that of fresh rat skin; and (2), to study the possible activating effect of antigen-antibody reactions on the proteolytic enzyme system of skin.

The proteolytic enzyme system of fresh rat skin has been studied using N-acetyl-L-tyrosine ethyl ester, L-tyrosine ethyl ester, and casein as substrates. The effects of ionic strength of extraction, time of extraction, time of hydrolysis of casein, ionic strength of assay, enzyme concentration, inactivation of proteinase activity as a function of time, inhibition of the hydrolysis of N-acetyl-L-tyrosine ethyl ester by a blood inhibitor, and of age were examined.

Fresh skin extracts of various animals were also tested for their ability to hydrolyze the substrates mentioned above. Activity towards N-acetyl-L-tyrosine ethyl ester was present in rat, guinea pig, sheep, and monkey extracts but absent in extracts of the other species examined. All extracts except those from cow and chicken skins contained activity towards L-tyrosine ethyl ester. Rat, guinea pig, and monkey skin extracts were the only extracts that possessed caseinolytic activity.

Since the substrate specificities of several of the skin enzymes resemble that of chymotrypsin in that aromatic amino acid esters and their acylated derivatives serve as susceptible substrates, a sensitive and rapid spectrophotometric assay procedure for these enzymes was developed by using chymotrypsin as the test enzyme. The method developed was capable of determining chymotrypsin activity with quantities of enzyme as small as 4.5 millimicrograms. This low enzyme requirement was achieved by the use of N-carbobenzoxy-L-tyrosine p-nitrophenyl ester as the test substrate in conjunction with the techniques of spectrophotometry to measure initial reaction velocities.

The hydrolysis of N-carbobenzoxy-L-tyrosine p-nitrophenyl ester by extracts of fresh rat skin has been compared with the hydrolysis of N-acetyl-L-tyrosine ethyl ester by the same extracts. Assays employing the two substrates were performed on a variety of fresh rat skin extracts and it was found that the data obtained were not capable of correlation. The results indicated that further studies were needed before the chromogenic substrate could be used for the assay of esterase activities present in skin extracts.

The immunological reaction selected to study the effect of hypersensitivity on the proteolytic enzyme system of rat skin was passive cutaneous anaphylaxis. This response was induced in the rat using the rabbit anti-egg albumin-egg albumin system. Extracts of skin undergoing this type of hypersensitivity were assayed against casein, N-acetyl-L-tyrosine ethyl ester, and L-tyrosine ethyl ester. It was found that no difference existed between the enzymatic activities of these extracts and those of control skin extracts.

It was decided to investigate the effect of antigen-antibody reactions on a more purified enzyme system. Proteinase C was selected as the test enzyme. Proteinase C was purified 23-fold in a yield of 42%. During the purification of this enzyme its inhibitor was removed. The inhibitor of Proteinase C was prepared by the acid inactivation of a skin extract.

Purified Proteinase C was inactivated by mixing the enzyme with its specific inhibitor. The inactivated enzyme solution was added to preformed antigen-antibody aggregates and no activating effect was observed. Similarly, no activating effect was found when the immune reaction was allowed to occur in the presence of inactivated Proteinase C.

The studies reported in this dissertation represent the first attempt to investigate the effect of antigen-antibody systems upon characterized enzymes of skin. No evidence, however, was obtained to corroborate the prevailing hypothesis which relates the antigen-antibody interaction to an activation of proteolytic enzymes.

Microfilm $2.75; Xerox $6.20. 129 pages.

THE CHEMICAL COMPOSITION OF HARDWOOD SMOKE

(Order No. Mic 61-2484)

Vilhelm James Jahnsen, Ph.D.
Purdue University, 1961

Major Professor: Dr. H. Ned Draudt

Smoke was produced by burning hickory sawdust in an all pyrex glass generator at temperatures below 400°C., constant air flow but varying moisture levels of 10 to 50%. The smoke was condensed in a cold trap train. Total acidity, carbonyl and phenolic content decreased with increased moisture in a manner suggesting a dilution effect.

10 to 30% moisture sawdust produced very acrid, and heterogeneous condensates, dark red in color which polymerized very quickly on standing at room temperature. 40 and 50% moisture sawdust produced relatively homogeneous suspensions, orange in color and of agreeable odor which kept their original appearance and quality much longer.

The chemical composition of 50% moisture sawdust was studied in detail. The total condensate was subjected to nitrogen stripping at low pressures. The volatile materials were collected at dry ice and liquid nitrogen temperatures. The volatiles and the residue were resolved by gas chromatography and identified by gas, paper, column chromatography, chemical methods and infrared analysis.

Gas chromatography of the volatiles involved the use of a 20 ft. DEGS column. 30% w/w on chromosorb 30/60 at 90°C. 15 elution curve peaks were obtained, including water. 10 were identified as acetaldehyde, acetone, methanol, ethanol, formic, acetic, propionic and butyric acid, diacetyl and water.

The residue was resolved by means of a 9 ft. polyethylene glycol succinate column using temperature programming throughout the run. 27 major peaks and 6 lesser peaks were obtained. Several closely related compounds were not separated. The components identified were: methanol, ethanol, formaldehyde, diacetyl, crotonaldehyde (?), acids formic, acetic, propionic, butyric plus

furfural, anisole, veratrole, guaiacol, 2,6-dimethyl phenol, the three cresols, 3,4 and 3,5-dimethyl phenol, thymol and 2,6-dimethoxy pyrogallol.

The residue was also subjected to precipitation with a 0.25M solution of basic lead acetate. Compounds which precipitated and were identified after regeneration with acid were guaiacol, creosol, formic acid, 2,6-dimethoxy-pyrogallol, catechol, pyrogallol, phloroglucinol. Compounds which did not react with basic lead acetate and were identified by paper chromatography were: anisole, the three cresols, veratrole, 2,6-, 3,4-, 3,5-xylenols, hydroquinone, thymol, vanillin and furfural.

The paper chromatographic technique used involved two solvent systems: n-butanol-acetic acid-water, 4:1:5 and benzene-formic acid-water. Color reagents were diazotized sulfanilic acid, potassium permanganate, brom-cresol green, formaldehyde-sulfuric acid and 2,4-dinitro-phenylhydrazine.

2,4-dinitrophenylhydrazones of smoke carbonyls were separated on an alumina column using 10% pyridine-ethyl acetate solvent. Acetone, acetaldehyde, formaldehyde, furfural and diacetyl were identified.

The largest component of smoke condensates, besides water, was acetic acid. The largest carbonyl was diacetyl and the largest phenols were guaiacol and 2,6-dimethoxy-pyrogallol. The alcohol found in largest amount was methanol.

29 compounds were isolated and identified in the condensates of hardwood smoke.

Microfilm $2.75; Xerox $4.80. 92 pages.

THE CATABOLISM OF GLUCONATE IN ESCHERICHIA COLI

(Order No. Mic 61-2422)

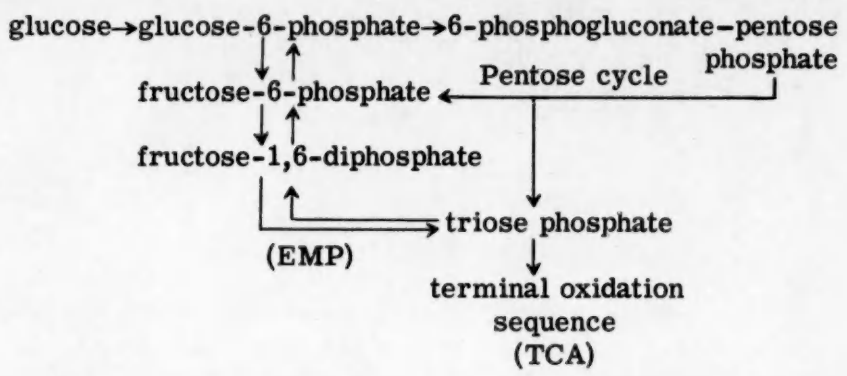
Dallas Eugene Jones, Ph.D.
Oregon State College, 1961

Major Professor: Chih H. Wang

Recent interests in the quantitative evaluation of two or more concurrent pathways of glucose catabolism in biological systems have led to the study of pathways of glucose utilization in Escherichia coli (ATCC 11303B). The results of radiorespirometric studies of $C^{14}O_2$ production from C^{14} specifically labeled pyruvate, acetate and glyoxylate in glucose grown cells indicated that the terminal oxidative pathway is primarily through the TCA cycle and possibly the glyoxylate bypass operating as a complementary mechanism.

The relative participation of individual pathways for glucose catabolism has been examined with a radio-respirometric study of glucose and gluconate. It appears that glucose catabolism is mainly via the glycolytic pathway (78 percent) and to a limited extent via the pentose phosphate pathway (22 percent). The latter is believed to be in the nature of the sequence which appears at the top of the following column.

The following conclusion was further verified with data obtained in incorporation experiments in which resting cells of E. coli incorporated labeling from gluconate carbon atoms into cellular alanine, aspartic and glutamic



acids as well as α ketoglutarate which accumulated in the incubation medium. The isotopic distribution patterns of the cellular amino acids, derived from labeled gluconate, rule out the possible operation of the Entner-Doudoroff pathway in this organism, but are in accordance with the suggested sequence for gluconate catabolism. The isotopic distribution patterns in α ketoglutarate, derived from labeled gluconate substrates, are also in line with the suggested sequence. In addition, data obtained in the α ketoglutarate experiment indicated that the glyoxylate cycle pathway, which involves isocitratase and malate synthetase as key enzymes, appears to be the main route for the net synthesis of C_4 acids from triose. The latter acids are in turn fed into the Krebs cycle leading to the net synthesis of α ketoglutarate.

The results obtained in the present study indicate that the speculative mechanism proposed by Katagiri for the biosynthesis of α ketoglutarate, namely, the condensation of pyruvate and acetate is not a probable mechanism for the production of α ketoglutarate.

Microfilm $2.75; Xerox $5.40. 107 pages.

THE SYNTHESIS OF PEPTIDES RELATED TO α-MELANOCYTE STIMULATING HORMONE AND THE CORTICOTROPINS

(Order No. Mic 61-1876)

Saul Lande, Ph.D.
University of Pittsburgh, 1961

Histidylphenylalanylarginyltryptophylglycine, formed by the N,N'-dicyclohexylcarbodiimide reaction of N^{α}-carbobenzoxy-L-histidyl-L-phenylalanylnitro-L-arginine and methyl-L-tryptophylglycinate, followed by catalytic hydrogenation, is optically impure as was indicated by its resistance to complete digestion by trypsin and leucine aminopeptidase. The 4-L isomer was obtained by fractional crystallization of the blocked pentapeptide ester. To show that the results of enzymatic digestion — indicating the presence of D-arginine — were valid, arginine from an acid hydrolysate of mother liquor pentapeptide was isolated via the flavianate. The arginine prepared in this manner was optically inactive while authentic L-arginine exposed to the same conditions retained its full optical activity. This direct chemical evidence indicates that the action of proteolytic enzymes provides a valid tool for the evaluation of the stereochemical purity of synthetic polypeptides.

Histidylphenylalanylarginyltryptophylglycine (4-L) is a key intermediate in the synthesis of larger peptides related

to the melanocyte stimulating hormones and the corticotropins. A method for providing optically pure pentapeptide in higher yield was desirable. [All amino acid derivatives are of the L-variety unless otherwise specified]. The reaction of a mixed anhydride of N^{α}-carbobenzoxyphenylalanylnitroarginine and isobutylchloroformate with methyl tryptophylglycinate, followed by saponification yielded N^{α}-carbobenzoxyphenylalanylnitroarginyltryptophylglycine. Deblocking with hydrogen bromide in acetic acid or by catalytic hydrogenolysis formed phenylalanylnitroarginyltryptophylglycine and phenylalanylarginyltryptophylglycine respectively. A reaction of the triethylammonium salts of the deblocked or partially deblocked tetrapeptides with the azide of N^{α}-carbobenzoxyhistidine yielded N^{α}-carbobenzoxyhistidylphenylalanylarginyltryptophylglycine and N^{α}-carbobenzoxyhistidylphenylalanylnitroarginyltryptophylglycine. Catalytic hydrogenation of both derivatives yielded histidylphenylalanylarginyltryptophylglycine. The optical purity of this product was indicated by its complete digestibility by leucine aminopeptidase and trypsin into the expected products. Since fractional crystallization to remove undesired diastereoisomers was not required, this method provides pentapeptide in yields five fold that of the originally reported method.

The complete removal of nitro-blocking groups from simple nitroarginine containing peptides requires catalytic hydrogenation for extended periods of time. Since the removal of nitro-blocking groups from higher molecular weight products may be even more difficult, the incorporation of peptides containing unblocked arginine into more complex polypeptides was studied. The dihydrochloride of N^{α}-carbobenzoxyhistidylphenylalanylarginyltryptophylglycine was reacted with the triethylammonium salts of N^{ϵ}-formyllysylprolylvalylglycine methyl ester and also with N^{ϵ}-formyllysylprolylvalylglycyl-N^{ϵ}-formyllysyl-N^{ϵ}-formyllysine amide using N,N'-dicyclohexylcarbodiimide as condensing agent to form the blocked nona- and undecapeptides. The blocked undecapeptide was also prepared from the same two subfragments via activation with N,N'-carbonyldiimidazole. Following catalytic hydrogenation and fractionation via ion exchange chromatography, the products were completely digestible with leucine aminopeptidase indicating that no racemization occurred during the coupling reactions. The synthesis of histidylphenylalanylarginyltryptophylglycyl-N^{ϵ}-formyllysylprolylvalylglycine and histidylphenylalanylarginyltryptophylglycyl-N^{ϵ}-formyllysylprolylvalylglycyl-N^{ϵ}-formyllysyl-N^{ϵ}-formyllysine amide, partially blocked subfragments of corticotropin, indicates that under certain conditions arginine containing peptides can be incorporated into peptides of higher complexity.

Experimental information concerning the stereospecificity of the target organ of the α-melanocyte stimulating hormone (α-MSH) and the minimal structural requirements for melanophoretic activity may provide a basis for the critical evaluation of theories concerning the mechanism of action of this hormone. Histidylphenylalanylarginyltryptophylglycine (4-L) has a measurable melanophoretic activity. Phenylalanylarginyltryptophylglycine and phenylalanylarginyltryptophylglycyl-N^{ϵ}-formyllysylprolylvaline amide (the C-terminus of α-MSH) in the same in vitro bioassay system are completely inactive, suggesting that a histidyl moiety is directly involved in the stimulation of the melanocyte by the hormone.

Exposure of racemic histidylphenylalanyl-(DL)-arginyltryptophylglycine to the proteolytic action of trypsin provided a means to isolate pure L-histidyl-L-phenylalanyl-D-arginyl-L-tryptophylglycine. The in vitro MSH activity of this substance is the same as that of the all-L isomer, indicating that the target organ is not stereospecific for an arginine moiety contained in a biologically active subfragment of the MSH molecule.

Microfilm $2.75; Xerox $5.00. 100 pages.

STUDY OF CELLULASE FROM RUMEN BACTERIA AND FROM RUMINOCOCCUS ALBUS

(Order No. Mic 61-2301)

James Murray Leatherwood, Ph.D.
North Carolina State College, 1961

Supervisor: Walter Earl Thomas

Characteristics of cellulase extracts from mixed rumen bacteria and from Ruminococcus albus cultural filtrates were studied. These extracts were prepared from bacteria collected from rumen fluid by extracting the bacteria with butanol-buffer solutions. Cultural filtrates of R. albus, grown on cellobiose-swollen cellulose medium, were also used as cellulase solutions.

The cellulase preparations were assayed by the change in fluidity of carboxymethylcellulose substrate solutions; the measurement of reducing substances produced from the hydrolysis of carboxymethylcellulose; and the measurement of glucose, reducing substances and anthrone-reactive soluble carbohydrates produced from the hydrolysis of swollen cellulose.

Cellulase from rumen bacteria exhibited maximum activity at pH 5.8 in all of the assay techniques. Cellulase from R. albus produced near maximum activity over a range of pH from 5.6 to 6.7, measured as reducing substances from swollen cellulose and carboxymethylcellulose and maximum activity at pH 5.8, measured by the change in fluidity of carboxymethylcellulose. Optimum temperatures for activity on carboxymethylcellulose were 45° C. for the rumen bacteria and 47° C. for R. albus cellulase.

Apparent Michaelis constants for carboxymethylcellulose (CMC 4 M) of 0.54 (% concentration) for the extracts from rumen bacteria and 0.26 for the R. albus cellulase solution were determined.

Relationships of ratios of five different measures of activity for three rumen-bacteria extracts and for three R. albus cellulase solutions were used to partially characterize the mechanism of the enzyme systems. Glucose was the main product of hydrolysis of swollen cellulose by the rumen-bacteria cellulase; while cellobiose was the apparent product of hydrolysis by R. albus cellulase. Swollen cellulose was more readily hydrolyzed in relation to the respective activity on carboxymethylcellulose by R. albus cellulase solution than by extracts from rumen bacteria.

Precipitations with ethanol, acetone or ammonium sulfate were unsuccessful as purification techniques for cellulases from rumen bacteria and R. albus. Swollen cellulose exhibited a highly specific adsorptive affinity for

cellulase, but various elution processes were unsuccessful in recovering the adsorbed activity.

Microfilm $2.75; Xerox $5.20. 105 pages.

THE ISOLATION OF CELLULAR LIPOPROTEINS

(Order No. Mic 61-1883)

Edward Anthony Napier, Jr., Ph.D.
University of Pittsburgh, 1961

A procedure has been developed for the separation of lipoproteins from rat heart and liver mitochondria and microsomes. Sonic disintegration of the cellular particulates in a phosphate medium of optimal ionic strength and pH (μ = 0.05, pH 7.6) for five minutes resulted in the liberation of lipoproteins into solution. Preparative ultracentrifugation of the supernatant from the sonicated suspension at varying densities of 1.10 to 1.21, yielded top fractions exhibiting flotation in the analytical ultracentrifuge.

The lipoproteins obtained from liver mitochondria were characterized as a group with regard to physicochemical and chemical properties. Density gradient studies of this lipoprotein fraction revealed a "family" of lipoproteins, analogous to those found in serum, with the principal components having a density range of approximately 1.14 to 1.16.

The heterogeneous lipoprotein fraction prepared at a density of 1.21, was observed to contain 29 per cent lipid and a principal component with a flotation coefficient ($-S_{1.21}$) of approximately 45 x 10^{-13} sec at 26°C. Silicic acid chromatography of the lipid moiety revealed 78% phospholipid, consisting predominantly of phosphatides of ethanolamine, serine, and choline, and 22% neutral lipid, 2 per cent of which was identified as coenzyme Q. Identification and quantitation of the fatty acid esters of the chromatographed lipid fractions were carried out by gas-liquid chromatography. The principal fatty acids in the lecithin and "cephalin" fractions were palmitate, stearate, linoleate and arachidonic acid; the triglyceride fraction consisted predominantly of stearate, oleate and linoleate.

Antimycin A-insensitive DPNH-cytochrome c-reductase and diaphorase activities were observed at low levels (0.3 and 0.1 units/min/mg protein, respectively) in the lipoprotein fraction derived from the rat liver mitochondria.

Microfilm $2.75; Xerox $5.40. 107 pages.

PREPARATION AND CHEMICAL STUDIES OF GLYCOPEPTIDES DERIVED FROM OVALBUMIN

(Order No. Mic 61-2319)

Richard Harold Nuenke, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor Leon W. Cunningham

The crystalline glycoprotein ovalbumin was heat denatured and digested with trypsin and α-chymotrypsin to give closely related glycopeptide fragments. The digest was fractionated with alcohol, and the 50-87% fraction was found to contain most of the carbohydrate with a four to five-fold enrichment over the original mannose content of 1.8%. Column chromatography of this fraction on DEAE-cellulose with a 5 x 10^{-4} M sodium phosphate buffer, pH 7.8, resulted in the elution of a glycopeptide peak immediately following the holdup peak. This fraction generally contained 39-45% mannose and was essentially free of non-glycopeptide components. Dinitrophenylation of the fraction resulted in mono-substituted DNP-glycopeptides, which have been further fractionated by countercurrent distribution, primarily using 2-butanol, 2% acetic acid. Two fractions have been obtained in this way which differed in their N-terminal amino acids. The major fraction possessed an N-terminal di-DNP-tyrosine residue, while the other fraction was devoid of tyrosine and had DNP-aspartic acid in the N-terminal position. However, complete homogeneity of a fraction has yet to be achieved, although other methods of column chromatography have been tried, principally Dowex-50 and ethanol elution from charcoal-Celite. Carboxypeptidase treatment of a glycopeptide fraction resulted in the rapid appearance of leucine and valine with a slower appearance of serine, threonine, and additional leucine. From these and other data the principal glycopeptide was determined to have the amino acid sequence: Tyr.Asp.Leu.(Thr,Ser)(Val,Leu). The carbohydrate was found to be attached to a carboxyl group of aspartic acid since 1) all other amino acids except tyrosine could be released by carboxypeptidase and 2) tyrosine was found to be absent in many fractions. The carbohydrate unit appeared to consist of 5 moles of mannose and 3 moles of N-acetylglucosamine. The mannose value was not precise and extreme values of 4.6 and 5.6 moles were found. The glucosamine content was 2.7 moles (Elson-Morgan test) and the acetyl content was 3.0. A minimum molecular weight of 2250 for the glycopeptide from its known composition was in agreement with the value determined experimentally by ultracentrifugation-diffusion studies using a synthetic boundary cell. Since only 0.3 moles of reducing group were found, the carbohydrate was believed to be bound to the aspartic acid through the number one carbon of the reducing end group of the polysaccharide. An ester linkage between peptide and carbohydrate was ruled out, since alkaline hydroxylamine failed to release the carbohydrate from either intact ovalbumin or from a DNP-glycopeptide fraction. One mole of ammonia was produced by mild acid hydrolysis of the glycopeptide with 1.5 N HCl at 100° for three hours. These facts suggested that the carbohydrate attachment to the peptide chain was through an acyl glycosylamine bond involving the aspartic acid carboxyl group, the ammonia residue, and the terminal reducing group of the carbohydrate unit. An abnormal resistance to proteolysis by chymotrypsin and carboxypeptidase was noted for residues near the aspartic acid. This suggested a steric hindrance to enzymatic attack resulting from the close proximity of the carbohydrate unit. Neuberger in 1938 [Biochem. J., 32, 1435 (1938)] isolated the ovalbumin polysaccharide following a long term tryptic digestion of the protein. For the most part his data are consistent with the structure proposed here, if it is assumed that his preparation retained the aspartic acid and ammonia residues and was not free of amino acids as he stated. Thus, long term digestions with crude trypsin and pancreatin in the present

study failed to remove the carbohydrate unit from a DNP-glycopeptide preparation. In contrast to Neuberger's findings on the polysaccharide, no positive Ehrlich's reaction was obtained following alkaline hydrolysis of the glycopeptide in 10% $Ba(OH)_2$ or 1 N NaOH for varying lengths of time. Microfilm $2.75; Xerox $7.60. 161 pages.

THE MECHANISM OF ACTION OF TRANSKETOLASE

(Order No. Mic 61-2501)

James Lawrence Rhoades, Ph.D.
Purdue University, 1961

Major Professor: Ralph C. Corley

The transketolase enzyme was prepared from baker's yeast according to the procedure of Srere et al. An improved assay procedure was developed based on the amount of xylulose produced by the action of the enzyme on lithium hydroxypyruvate and glyceraldehyde. The xylulose was determined by the cysteine-carbazole method.

The report that formaldehyde functioned as an aldehyde acceptor to produce dihydroxyacetone could not be confirmed. Acetaldehyde was found to give rise to a new component in the presence of the enzyme and lithium hydroxypyruvate. This component had an R_f of 0.64 in butanol: acetic acid:water (4:1:5) solvent. The osazone of this new component did not correspond to the osazone reported for the expected product, 4-deoxy-L-erythrulose.

Thiamine pyrophosphate, which is a transketolase coenzyme, did not catalyze the decomposition of lithium hydroxypyruvate at pH 8.0 or 6.6 at 40°C. The transketolase enzyme also did not catalyze this reaction under similar conditions.

The transketolase enzyme is stereospecific for the L-configuration on the third carbon of the keto group donor with the exception of hydroxypyruvate. This specificity indicates strongly that there is definite linkage between this carbon of the ketose and the enzyme.

A mechanism is proposed in which the first step is the formation of an enzyme-thiamine pyrophosphate-ketose complex. The binding and the functioning of the thiamine pyrophosphate is in accord with Breslow's mechanism of thiamine catalysis. Thus, the binding is to the active form of thiamine and to a cationic site on the enzyme.

The binding of the ketose to the enzyme was studied by conducting the enzymatic reaction in the presence of tritiated water and determining the amount of hydrogen exchanged. This study showed that there was no significant incorporation of tritium into either the substrates or the products of the reaction. The lack of incorporation of tritium during the action of the transketolase showed that there is no interaction between a carbon bound hydrogen and the water solvent. It is also considered evidence for the carbon-oxygen-enzyme type of linkage between the third carbon of the ketose and the enzyme.

A recent report of Racker indicates that it is possible to precipitate an active enzyme complex from a mixture of the enzyme and a keto group donor with ethanol. To check the existence of the ketose complex, the reaction between the enzyme and xylulose, labelled with tritium on the first carbon, was studied. A protein similar to the enzyme but containing no measurable activity was used as the control. One would expect that the enzyme protein would bind more xylulose per milligram of protein than the control. The results did not justify this conclusion. An entirely unexpected result is the occurrence of a glycolaldehyde component in both the enzyme and the non-enzyme protein. This was presumably due to the presence of an enzymatic activity of the latter.

The presence of a small amount of transketolase activity is discounted. However, the possibility exists that the control and enzyme proteins were the same prior to the extraction from yeast. The preparatory procedure may have resulted in an alteration in the protein structure so that the non-enzyme protein would no longer react with the lithium hydroxypyruvate-glyceraldehyde assay reaction but would still react to bind xylulose and to produce glycolaldehyde. Microfilm $2.75; Xerox $6.20. 129 pages.

THE DISTRIBUTION OF S^{35} FROM LABELED METHIONINE AMONG THE PLASMA PROTEINS OF TUMOR-BEARING AND PROTEIN-DEPLETED DOGS

(Order No. Mic 61-2193)

Thomas J. Russell, Jr., Ph.D.
Rutgers University, 1961

Major Professor: Dr. James B. Allison

Previous work at the Bureau of Biological Research, Rutgers University, New Brunswick, New Jersey has demonstrated an increased uptake of S^{35} from methionine in the plasma proteins of protein-depleted dogs, as compared to control animals. This evidence suggested the use of S^{35} as a means of investigating metabolic changes brought about by internal physiological stress. The data did not, however, indicate which proteins of the plasma complex were responsible for changes in the uptake of isotope. Experiments were designed, therefore, to measure metabolic alterations as a function of S^{35} incorporation in the individual plasma or serum proteins of adult dogs suffering from cancer and protein-depletion. The activities of isotope specified for these studies were so low that separation and counting of the serum proteins on electrophoretic paper strips was not possible. This circumstance necessitated an adaptation of the Cohn ethanol fractionation, Method 10, to the separation of plasma proteins in quantities large enough to emit statistically significant levels of activity. Subsequent to these fractionations, a less laborious method for the physical separations of serum proteins was found in a modified curtain electrochromatographic technique.

Incorporation of S^{35} from methionine in ethanol fractionated albumins from protein-depleted dogs increased compared to the normal controls. This increase was evidenced in spite of a decrease in the actual concentration of the circulating albumins. The concentration and uptake of label in albumins from tumor-bearing dogs, on the other hand, did not differ significantly from the normal controls. Electrochromatographically separated albumins taken from dogs depleted over four and eight weeks respectively,

showed a decrease in S^{35} uptake in the albumins from the more severely depleted animals.

A significant finding to come from these experiments was the discovery that the beta-lipoprotein fraction showed a marked increase in S^{35} uptake in tumor-bearing and protein-depleted dogs, although the concentration of these globulins remained constant. In view of the constant globulin and albumin concentrations, neither albumin determinations or albumin/globulin ratios would be of use in detecting early metabolic alterations caused by tumor growth. The uptake of S^{35}, however, rose markedly in the beta-lipoprotein fraction from cancer animals and served to detect early changes in protein metabolism caused by growth of the tumor.

The specific activity of the gamma globulins increased in protein-depleted dogs but remained constant in tumor-bearing animals. A slight increase in the concentration of these globulins was noted in protein-depleted animals, but no change was observed in the cancer dogs. The incorporation of S^{35} in the alpha globulins showed no significant change among the three groups of animals. Similarly, the concentration of these globulins did not alter under conditions of cancer of protein-depletion.

Distribution of radioactivity among the serum proteins of four and eight week depleted dogs was studied by curtain electrochromatography. It was shown that at four weeks depletion, the highest percentage of total activity for a given sample was located in the beta-lipoprotein fraction, followed in decreasing order by the alpha globulins, gamma globulins, and the albumins. Serums from animals depleted for eight weeks, however, exhibited a shift in distribution of activity such that the highest percentage of the total activity was now found in the alpha globulin fraction followed by the beta-lipoproteins, gamma globulins, and albumins.

Results from these experiments were examined for compatibility with current understanding of the dynamic steady state. The evidence was then integrated with other data obtained in this laboratory to construct a hypothesis concerning the mechanisms involved in regulation of protein metabolism in the whole animal.

Microfilm $2.75; Xerox $5.60. 113 pages.

RESPIRATION AND PHOSPHORYLATION IN HEART AND LIVER MITOCHONDRIA ISOLATED FROM ALTITUDE ACCLIMATIZED RATS

(Order No. Mic 61-2403)

Erasmus Hardin Strickland, Jr., Ph.D.
The Pennsylvania State University, 1961

Studies were made to determine the effect of altitude on respiration and phosphorylation of liver and heart mitochondria. Adult rats were exposed continuously to simulated altitudes of 17,000, 20,000 or 21,000 feet for 6 weeks. Respiratory and phosphorylative activities were measured polarographically with the oxygen electrode. The P:O values for succinate, beta-hydroxybutyrate, and alpha-ketoglutarate respiration were unchanged in liver mitochondria isolated from altitude exposed rats. Supplementary studies showed that the alpha-ketoglutarate P:O value was also unchanged in heart mitochondria isolated from acclimatized rats.

In contrast to the results of the phosphorylative studies, respiration was altered in mitochondria isolated from altitude exposed rats. The respiratory rates of liver mitochondria in the presence of excess ADP and succinate, beta-hydroxybutyrate, or alpha-ketoglutarate declined 10 to 30% in mitochondria isolated from rats exposed to 21,000 feet. In the case of liver mitochondria from rats exposed to 17,000 feet, no altitude effects were observed. The decreased respiratory capacity in liver mitochondria isolated from rats following exposure to 21,000 feet does not appear to be an adaptive change.

On the other hand, heart mitochondria isolated from rats exposed to 17,000 feet did show adaptive changes. These changes appear to be due to a slightly increased concentration of functional respiratory chain units relative to mitochondrial nitrogen and a slightly decreased functional ATPase activity. These changes in heart mitochondria may be important adaptive mechanisms under some conditions of altitude exposure.

Microfilm $2.75; Xerox $5.60. 114 pages.

DDT-DEHYDROCHLORINASE IN THE MEXICAN BEAN BEETLE, EPILACHNA VARIVESTIS (MUL.).

(Order No. Mic 61-2194)

Averett Snead Tombes, Ph.D.
Rutgers University, 1961

Major Professor: Dr. Andrew J. Forgash

The Mexican bean beetle has been known for some time to be naturally tolerant to certain chlorinated hydrocarbons. An earlier investigation demonstrated a possible mechanism for this resistance by showing the presence of the enzyme DDT-dehydrochlorinase in the Mexican bean beetle. The enzyme level throughout various stages of the beetle was determined and found to increase in proportion to the body weight (dry weight) except in the pupal stage. At this stage in the insect's development there was a 33 per cent reduction in enzyme activity; following adult feeding, however, the dehydrochlorinase returned to the previous level.

Activity of this enzyme was found to be dependent on the nutritional state of the adult. Following a starvation period of only 3 days, the enzyme level of the adult was reduced 80 per cent, but rapidly returned to a normal level following the initiation of feeding. On the basis of this evidence, it is concluded that the enzyme experiences a reduction in activity due both to the indiscriminate hydrolysis associated with the catabolism and anabolism during metamorphosis and to the preferential utilization of the body protein reserve. This reduction in enzyme activity might also result from a decrease in the activity of some physiological function during pupation or starvation to which this dehydrochlorinating enzyme is closely associated.

Log dosage-probit lines for topical applications of TDE were determined with various stages of the beetle. In the adult stage the LD_{50}s, expressed in μg. TDE per mg. dry

weight, showed a close correlation with the enzyme level, expressed in μg. TDE dehydrochlorinated per mg. dry weight, except for the 3 days following eclosion. During these 3 days cuticular permeability is greater than that observed later when the exoskeleton hardens. In the larval stages no correlation between LD_{50}s and enzyme level was observed.

The adult tissues were dissected and assayed for enzyme activity. The reproductive organs possessed 2.5 times the activity observed in the second most active tissue, the alimentary canal. The other tissues in order of decreasing enzyme activity were: exoskeleton, flight muscles, central nervous system, and fat bodies.

On the basis of the tissue analysis results, it is concluded that the enzyme must function in one or both of the following roles. It may mediate a reaction associated with the reproductive process, or it may serve as protein reserve, located possibly in several tissues, and be utilized when the organism is under protein depletion.

Microfilm $2.75; Xerox $4.00. 77 pages.

PART I. THE STRUCTURE OF LAMINARIN. PART II. END-GROUP ANALYSIS AND THE MOLECULAR WEIGHT OF POLYSACCHARIDES.

(Order No. Mic 61-2167)

Abraham Martin Unrau, Ph.D.
University of Minnesota, 1959

PART I. THE STRUCTURE OF LAMINARIN

Laminarin, a seaweed polysaccharide, is found in considerable quantities in the brown algae, Phaeophyceae. Laminarin which is extracted from Laminaria digitata is cold-water soluble whereas laminarin from Laminaria cloustoni is cold-water insoluble. Both forms were shown to contain D-glucose (86-96%), D-mannose (2-7%), and D-mannitol (2-4%).

Periodate oxidation of laminarin (insoluble form) before and after reduction with potassium borohydride, and electrophoresis on glass paper, indicated that laminarin was heterogeneous. Laminarin was shown to consist of two components, one polymer containing D-glucose and D-mannose, possessed reducing properties and was referred to as laminarose; the other, a non-reducing polymer containing D-glucose, D-mannose and D-mannitol, was designated laminaritol. The mixture was resolved by bromine oxidation of laminarose to laminaric acid and adsorption of the latter on an anion-exchange resin.

Hydrolysis of laminaric acid gave (molar ratios) D-glucose (13), D-mannose (1), and D-gluconic acid (1). The D.P., determined by titration and by periodate oxidation followed by formaldehyde determination, was about 15. The D-glucose residue at the reducing end of laminarose was linked through C_3, since periodate oxidation of laminarin followed by reduction and hydrolysis gave D-arabitol.

Methylation and hydrolysis of laminaric acid gave (molar ratios) (a) 2,3,4,6-tetra-O-methyl-D-glucose (2), (b) 2,4,6-tri-O-methyl-D-glucose (9), (c) 2,3,4-tri-O-methyl-D-glucose (1), (d) 2,4,6-tri-O-methyl-D-mannose (1), (e) 2,4-di-O-methyl-D-glucose (1) and (f) 2,4,5,6-tetra-O-methyl-D-gluconic acid (1). Components (a) and (f) came from terminal units, the former from the non-reducing and the latter from the reducing end of laminarose. Components (b), (c), (d) and (e) were derived from non-terminal residues, (b) and (d) from the 1 → 3 linked D-glucose and D-mannose units immune to periodate attack, while (c) was formed from a periodate-labile 1 → 6 linked D-glucose unit, and (e) from a branch point.

Investigations using periodate oxidation, reduction and mild acid hydrolysis agreed with the methylation results, and suggested further that the 1 → 6 linkage occurred between the branch point and a non-reducing end. A general formula for laminarose is therefore:

$$G(1\rightarrow 3)H_a(1\rightarrow 6)G(1\rightarrow 3)H_b(1\rightarrow 6)G(1\rightarrow 3)H_c(1\rightarrow 3)G(1\rightarrow 3)H_d(1\rightarrow 3)G$$

G = D-glucose

H = D-glucose and D-mannose

a + b + c + d = 10 (approx.).

Hydrolysis of laminaritol gave (molar ratios) D-glucose (27), D-mannose (2) and D-mannitol (1). The proportion of D-mannitol, as well as the proportion of formaldehyde produced after periodate oxidation, suggested that the D.P. of laminaritol was about 30.

Methylation and hydrolysis of laminaritol gave (molar ratios) (a) 2,3,4,6-tetra-O-methyl-D-glucose (4), (b) 2,4,6-tri-O-methyl-D-glucose (18), (c) 2,3,4-tri-O-methyl-D-glucose (2), (d) 2,4,6-tri-O-methyl-D-mannose (2), (e) 2,4-di-O-methyl-D-glucose (2) and (f) 3,4,5,6-tetra-O-methyl-D-mannitol (1). Laminaritol contained therefore two branch points, two 1 → 6 linkages, two D-mannose units and one D-mannitol residue joined to two polymeric chains through C_1 and C_3.

Periodate degradations of laminaritol gave results which were in agreement with the methylation results and the formula of laminaritol may therefore be written thus:

$$R\longrightarrow 1\ M\ 2\longleftarrow R$$

R = laminarose

M = D-mannitol

PART II. END-GROUP ANALYSIS AND THE MOLECULAR WEIGHT OF POLYSACCHARIDES

The terminal reducing residue of a polysaccharide may be transformed to the corresponding alditol residue by potassium borohydride reduction. Hydrolysis of reduced corn starch dextrin, amylose and cellulose gave D-glucitol; likewise D-xylitol was obtained from reduced applewood hemicellulose.

Reduction of mono-, di-, and oligosaccharides followed by periodate oxidation gave the theoretical proportions of formaldehyde. These reactions were applied to polysaccharides to determine the average degree of polymerization (D.P.). In the procedure, the periodate and iodate ions were precipitated as lead salts, and the formaldehyde separated from the polyaldehyde by dialysis of the oxidation mixture against distilled water.

The D.P. was determined for about 50 polysaccharides and, except for amylopectin and glycogen, the values

were in general agreement with those reported in the literature. Microfilm $3.25; Xerox $11.50. 252 pages.

CHEMISTRY, INORGANIC

PREPARATION AND STRUCTURAL PROPERTIES OF SOME FLUOROMETALLATES OF URANIUM AND GROUP V METALS

(Order No. Mic 61-2200)

Ann Eldora Baker, Ph.D.
University of New Hampshire, 1961

In previous work alkali fluorometallates of some transition and post-transition metals were prepared from methanol solution. The method of preparation consisted of bromination of the metal in methanol and subsequent precipitation of the fluorometallate by addition of the bromination solution to a solution of the alkali fluoride in methanol. This work is a continuation and extends the method of preparation to some ammonium and potassium fluorometallates of uranium, vanadium, niobium and tantalum.

A study of the bromination of uranium in methanol indicated the following reactions to be involved.

(1) $U^0 + 2Br_2 \rightarrow UBr_4$

(2) $U^0 + 3UBr_4 \rightarrow 4UBr_3$

(3) $UBr_3 + 2CH_3OH \rightarrow U(OCH_3)_2Br_2 + 1/2H_2 + HBr$

(4) $2U^0 + 6HBr \rightarrow 2UBr_3 + 3H_2$

(5) $UBr_3 + 1/2\ Br_2 \rightarrow UBr_4$

(6) $UBr_4\ 2CH_3OH \rightarrow U(CH_3O)_2Br_2 + 2HBr$

(7) $U(OCH_3)_2Br_2 + 2CH_3OH \rightarrow U(OCH_3)_4 + 2HBr$

(8) $U(OCH_3)_4 \rightarrow \underline{UO_2} + 2(CH_3)_2O$

(9) $U(OCH_3)_4 + Br_2 \rightarrow U(OCH_3)_4Br_2$

It is postulated that the niobium, tantalum and vanadium bromides also react with methanol to give hydrogen bromide which then acts as a second oxidizing agent in the bromination reactions, hydrogen being evolved.

A study of the precipitation reaction of the fluoroniobates and tantalates from methanol showed interference of water to give mixtures of oxy-compounds. Water was introduced as an impurity in ammonium fluoride. Anhydrous ammonium fluoride was prepared by precipitation from methanol by the addition of ether. Water was also introduced by the reaction of hydrogen bromide with methanol during the bromination step. Water from this source was kept at a minimum by the use of a large excess of bromine.

Bromine interfered in the preparation of the fluorometallates by reaction with ammonium fluoride in methanol to form monobromoamine and with potassium fluoride in methanol to form insoluble potassium hydrogen fluoride. The use of a large excess of the alkali fluoride and extensive washing of the potassium complexes with methanol solved these problems.

The fluorometallates prepared in this study were $(NH_4)_3UO_2F_5$, $K_3UO_2F_5$, $(NH_4)_3NbOF_6$, K_3NbOF_6, $(NH_4)_3TaOF_6$, K_3TaOF_6, $(NH_4)_3VOF_5$, and K_3VOF_5.

From powder diffraction data the niobium and tantalum complexes were found to be isostructural and are cubic, face-centered. Four formula units were included in each unit cell. The cell constants were found to be:

$(NH_4)_3NbOF_6$	"a" = 9.32 Å
$(NH_4)_3TaOF_6$	"a" = 9.31 Å
K_3TaOF_6	"a" = 8.90 Å

The cell constant found by other workers for K_3NbOF_6 was 8.88 Å.

The uranium and vanadium complexes were found to be tetragonal and contained eight formula units per unit cell. The cell constants were found to be:

$(NH_4)_3UO_2F_5$	"a" = 9.70 Å, "c" = 18.91 Å
$(NH_4)_3VOF_5$	"a" = 9.17 Å, "c" = 17.64 Å
K_3VOF_5	"a" = 8.75 Å, "c" = 17.09 Å

The cell constants for $K_3UO_2F_5$ have been found by other workers to be "a" = 9.160 Å, and "c" = 18.167 Å.

Magnetic susceptibility measurements showed the vanadium complexes to contain one unpaired electron. The magnetic moment of $(NH_4)_3VOF_5$ was found to be $1.68 \pm 0.05\beta$, that of K_3VOF_5 $1.71 \pm 0.03\beta$.

Infrared studies on the ammonium complexes showed very little or no hydrogen bonding in the niobium and tantalum complexes. Results for the vanadium complex were inconclusive, while those for the uranium complex suggested the presence of hydrogen bonding.

Microfilm $2.75; Xerox $4.40. 84 pages.

SOLVOLYSIS KINETICS OF PYRIDINE-BORANES

(Order No. Mic 61-2228)

Ernest Rodman Birnbaum, Ph.D.
The University of Florida, 1961

Pyridine-borane undergoes slow solvolysis in n-propanol to give hydrogen, the free amine, and propylborate as products. It was proposed that a kinetic investigation of this reaction for pyridine-borane, and a series of alkyl-substituted pyridine-boranes would yield a correlation between the structures of these compounds and the reactivities of their N-B-H bonds.

The alkyl-substituted pyridine-boranes studied in this work were 4-picoline-borane, 3-picoline-borane, 2-picoline-borane, 2-ethyl-pyridine-borane, 2,4-lutidine-borane, and 2,6-lutidine-borane. Solvolysis rates were obtained from following the loss of reducing power of the solution by iodate titration.

A first order dependence on amine-borane was found in each case. It was further observed that the rate of the solvolysis reaction was quite sensitive to changes in dielectric constant of the solvent, decreasing rapidly with increasing dielectric constant. Application of Kirkwood's relationship, $\log k = a + b(D-1)/2D + 1)$, to pyridine-borane in propanol-water mixtures (it was determined

that the reaction with water was negligible compared with that of the alcohol) yielded an excellent straight-line-plot. Since such a straight line could only be obtained from the Kirkwood equation if there were no rate-dependency on the solvent, it was concluded that the solvolysis was zero order in alcohol. Similarly, the solvolysis rate was independent of the addition of amine.

From the Arrhenius activation energies obtained from the solvolysis reaction, it was possible to show that the transition state for this reaction has a smaller steric requirement than that for the association reaction between an amine molecule and a borane group to form an amine-borane molecule. Consistent with these observations would be a mechanism such as:

$$\text{amine}\cdot BH_3 \xrightarrow[\text{slow}]{k_r} \text{amine} + BH_3 \xrightarrow[\text{fast}]{ROH} \text{Products}$$

Microfilm $2.75; Xerox $5.00. 98 pages.

FLUOROCARBON POLYPHOSPHINE CHEMISTRY

(Order No. Mic 61-2530)

Louis Russell Grant, Jr., Ph.D.
University of Southern California, 1961

Chairman: Professor Burg

The purpose of this investigation was to synthesize and to study the chemistry of new trifluoromethyl-substituted phosphines.

1,1-Dimethyl-2,2-bis-trifluoromethyl-biphosphine, $(CH_3)_2PP(CF_3)_2$, was prepared from $(CH_3)_2PH$ and $(CF_3)_2PCl$. Water and HCl cleaved the P-P bond and formed $(CF_3)_2PH$ in high yields; methyl iodide induced disproportionation and gave $P_2(CF_3)_4$ and $P_2(CH_3)_5I$; trimethylamine formed an adduct and $(CF_3)_2PH$ was generated from the action of HCl on the adduct. $(CH_3)_2PP(CF_3)_2$ acted as a monofunctional base toward diborane; pyrolysis of the adduct led to the formation of $(CF_3)_2PH$, $(CH_3)_2PBH_2$ polymers and a residue which consisted of $(CF_3)_2P$, $(CH_3)_2P$, and BH units. Thermal decomposition of the biphosphine occurred at 110° C. by an internal rearrangement.

Tetrakis-trifluoromethyl-biphosphine, $P_2(CF_3)_4$, behaved as a pseudohalogen in its reactions with ethylene, acetylene, and tetrafluoroethylene. The addition of $P_2(CF_3)_4$ into the double bond of ethylene took place at room temperature and $(CF_3)_2PC_2H_4P(CF_3)_2$ was the major product. At a slightly elevated temperature, 65° C., the compound was produced in slightly lower yields, while the yields of the by-products $[(CF_3)_2PC_2H_4]_2PCF_3$ and $(CF_3)_3P$ were increased. The reaction was noticeably slower in the absence of light. The diphosphine $(CF_3)_2PC_2H_4P(CF_3)_2$ showed basic character toward diborane.

The addition of $P_2(CF_3)_4$ into the double bond of C_2F_4 was promoted by a catalytic amount of iodine at 165° C. The main product of the addition was $(CF_3)_2PC_2F_4P(CF_3)_2$. A complex mixture of cyclo-C_4F_8, $(CF_3)_3P$, and possibly a new heterocyclic phosphine, $CF_3PC_4F_8$, was formed during the reaction. Evidence for the presence of the heterocyclic phosphine was obtained mainly from basic hydrolysis studies. The isolation of it in a pure form was extremely difficult.

Acetylene reacted with $P_2(CF_3)_4$ at 100° C. in the presence of a trace amount of iodine. A complex mixture was obtained which consisted of $(CF_3)_2PCHCHP(CF_3)_2$, $(CF_3)_3P$, $(CF_3)_2PCHCHCF_3$, and $[(CF_3)_2PCHCH]_2PCF_3$ as the identified volatile products. Infrared spectroscopic analyses of the diphosphine indicated the presence of the trans-isomer only; $(CF_3)_2PCHCHCF_3$, however, appeared to be present as a mixture of the cis- and trans-isomers. The action of diborane on the phosphines which contained unsaturated carbon to carbon linkages served to define the extent of unsaturation. Chemical and physical methods of analyses identified the resulting products as hydroborated materials. Evidence for the existence of the $(CF_3)_2PCHCHP(CF_3)_2$-B_2H_6 reaction product as a mixture of monomer and $B\overset{H}{\underset{H}{}}B$ bridged dimer was obtained from molecular weight determinations and infrared spectroscopy.

A tetra-phosphino-ethane was not obtained from excess $(CF_3)_2PCHCHP(CF_3)_2$ and $P_2(CF_3)_4$. The failure to observe multiple addition may be ascribed partly to greater delocalization of the pi electrons in the mono-addition compound than in acetylene itself. The steric requirements of the $(CF_3)_2P$ groups may also be a contributing factor.

This study offered numerous examples which indicated the ease with which CF_3 groups migrated from one phosphorus atom to another under the influence of nucleophilic agents.

A quantitative analysis for CF_3 groups in diphosphines was developed by the use of iodine. When excess iodine was used the CF_3 groups were removed quantitatively as CF_3I and HCF_3.

Phosphine served as an excellent reducing agent for CF_3PI_2 and gave CF_3PH_2 in high yields. Trimethylstibine acted as a dechlorinator of $(CF_3)_2PCl$ to form $(CF_3)_2PP(CF_3)_2$; or with CF_3PCl_2 it gave a mixture of CF_3P ring polymers.

This study has resulted in a general extension of the field of diphosphine chemistry. It has provided a new synthetic route for such compounds and has also indicated ways by which new phosphorus compounds containing boron can be prepared.

Microfilm $2.75; Xerox $6.00. 122 pages.

COORDINATION COMPOUNDS OF NICKEL(II)

(Order No. Mic 61-2379)

Dimitrios George Karipides, Ph.D.
The Pennsylvania State University, 1961

The purpose of this research was to make a systematic study of some coordination compounds of nickel(II). The study included the preparation of coordination polymers, separation of isomers, and preparation and study of coordination compounds of nickel(II).

A series of bis(potassium xanthates) of the type, KSSCO-Y-OCSSK, where Y=$(CH_2)_4$, $(CH_2)_6$, p-C_6H_4, m-C_6H_4, $(CH_2)_2S(CH_2)_2$, and $(CH_2OCH_2)_n$, and the corresponding

polymeric nickel derivatives were prepared. The polymeric nickel xanthates containing the linkage $(CH_2OCH_2)_n$ showed fiber formation, especially in the case of the polyethylene glycol xanthates where fibers of almost any length could be obtained. However, this fiber formation was offset by their low stability. Although the stability of the nickel polyethylene glycol xanthates was not great, their behavior indicated that nickel coordination polymers could be prepared.

A series of bis(hydrazides) and the corresponding polymeric nickel derivatives were prepared, but the extreme water solubility and difficulty in purification limited further consideration of these materials. To some degree, fiber formation was demonstrated when a limited amount of water was present with the nickel hydrazides.

Attempts to separate cis-trans isomers of nickel derivatives of unsymmetrical β-diketones by column chromatography were not successful. When the dipyridine derivatives of the nickel β-diketonates were passed through alumina and silica columns, they decomposed.

Two forms of nickel methylphenylglyoximate were separated on the basis of their differing solubilities in acetone-water mixtures. The two forms, a high melting red form and a low melting orange form, were assigned the trans and cis configurations, respectively, on the basis of their infrared spectra.

A series of nickel dithiophosphorus compounds of the type, $(RR'PS_2)_2Ni$, and their dipyridine and di-γ-picoline addition compounds were prepared. Attempts to prepare the corresponding di-α-picoline addition compounds were unsuccessful. This was traced to steric hindrance caused by the α-methyl group. Attempts to separate cis-trans isomers, and attempts to show evidence for a tetrahedral configuration of $[(C_6H_5)(C_2H_5O)PS_2]_2Ni$ were unsuccessful. A preliminary study of the visible spectra of the nickel dithiophosphorus compounds was made.

Nickel diphenylselenothiophosphinate, $[(C_6H_5)_2PSeS]_2Ni$, and its dypiridine and di-γ-picoline addition compounds were prepared.

Microfilm $2.75; Xerox $5.60. 113 pages.

THE PREPARATION AND ELECTRICAL PROPERTIES OF SOME LOW SODIUM CONTENT TUNGSTEN BRONZES

(Order No. Mic 61-1508)

William McNeill, Ph.D.
Temple University, 1961

The preparation and electrical properties are described for cubic sodium tungsten bronze, Na_xWO_3, single crystals having sodium concentrations of $x = 0.363$, 0.291, and 0.234.

The preparation of these crystals was carried out in two steps. First, cubes of $Na_{0.698}WO_3$ were prepared by the reduction with tungsten metal of a fused mixture of Na_2WO_4 and WO_3. The mole ratio of the reactants was $Na_2WO_4 : WO_3 : W = 5:5:1$. This mixture was heated to 1000°C and then cooled to 400°C at approximately 6°/hr. Well-defined cubes of Na_xWO_3 with a maximum dimension of 5mm were obtained. These crystals were cleaved along 100 planes to yield rectangular single crystal rods approximately 0.5x0.5x3.0 mm. The room temperature electrical resistivity for these rods was 3.31×10^{-5} ohm cm, in very good agreement with previously reported values.

The sodium concentration in the single crystal rods of $Na_{0.698}WO_3$ was decreased by heating them in contact with mixtures of powdered Na_xWO_3 and WO_3. Na_xWO_3 is subject to oxidation at temperatures of the order of 600°C and higher, and also can decompose in the absence of oxygen at somewhat higher temperatures. The latter reaction does not proceed rapidly below temperatures of the order of 1000°C. It was therefore necessary to carry out the equilibration of the Na_xWO_3 single crystals and WO_3 powder at pressures of less than 10^{-5}mm Hg, and at temperatures of 910 to 930°C. The equilibration time under these conditions was 216 hours, with single crystal rods of the above dimensions.

The final sodium concentration in the single crystal rods was determined from precision powder X-ray diffraction patterns obtained for pieces chipped from the single crystals. The lattice parameter of cubic Na_xWO_3 has been shown to be a linear function of the sodium concentration for x values above 0.26 and thus the present measurements involve only a small extrapolation. The Na_xWO_3 crystals for which electrical properties were measured were shown to be single crystals by X-ray back reflection measurements. The homogeneity of these crystals with respect to sodium was shown by the absence of significant broadening of the 422 line in the powder X-ray diffraction patterns.

Electrical resistivity was measured by a four point, potentiometric, null current method that eliminated the contributions from contact resistances. Values were obtained with both increasing and decreasing temperatures in the approximate range -190° to +100°C. Thermal hysteresis was not evident.

The thermoelectric power of the same Na_xWO_3 crystals was also measured over the approximate temperature range -190 to +100°C. All values for cubic single crystals of Na_xWO_3 with $x > 0.23$ were negative and did not exceed $30\ \mu v/°C$.

Differential thermal analysis of Na_xWO_3 powders in the range $x = 0.698$ to 0.15 was carried out to determine whether a low temperature structural transition is present. None was observed in the approximate temperature range -190° to +25°C. The resistivity-temperature curves show a more complex electronic behavior than had been predicted for Na_xWO_3 with x lower than 0.5 on the basis of earlier work. $Na_{0.363}WO_3$ exhibits a small temperature dependence of resistivity with what appears to be a minimum at about 125°K. Above this value the resistivity increases slowly with temperature. $Na_{0.291}WO_3$ exhibits a resistivity minimum at about 150°K and a positive temperature coefficient of resistivity above this value. In $Na_{0.234}WO_3$ the resistivity minimum occurs at about 320°K. A plot of $\log_{10}$ conductivity vs reciprocal temperature for $Na_{0.234}WO_3$ shows that Egap for conductance approaches zero. The above electrical behavior is similar to that of degenerate semiconductors. The resistivity minima may be a saturation effect, but ionized impurity scattering is probably present also.

A polycrystalline sample of $Na_{0.025}WO_3$ was obtained from a single crystal of $Na_{0.698}WO_3$ by heating it in WO_3 at 910°C. Four successive heating cycles were employed, each of 19 hours duration and each time the crystal was

repacked in fresh WO_3. The room temperature resistivity and Seebeck coefficient for this sample were $3x10^{-3}$ ohm cm, and $-270 \mu v/^\circ C$, respectively.

Microfilm $2.75; Xerox $4.20. 76 pages.

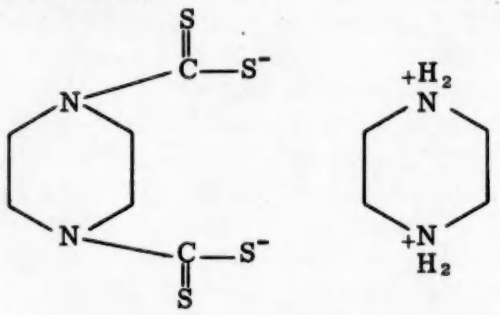
COORDINATION CHEMISTRY OF PIPERAZINE AND PIPERAZINE DERIVATIVES

(Order No. Mic 60-6021)

Frederick Woods Obear, Ph.D.
University of New Hampshire, 1961

Because piperazine has been shown to exist as a complex oscillator between two conformations – a chair form and a boat form – it was felt that it should be possible to freeze the heterocyclic ring system in the boat form by establishing a stable bridge between the nitrogen atoms. It has been shown, however, that coordination of metal ions by piperazine in aqueous solution is very much limited by the geometry requirements of the system and steric factors resulting from the size of the piperazine ring. Instead of metal-piperazine complexes, the isolated products have been shown by analyses and by powder pattern data to be hydrated oxides.

The structure of thioid, the reaction product of piperazine and carbon disulfide, has been questioned for some time. From analysis, molecular weight, and spectral data, thioid is believed to be a dimer having a structure illustrated by the following:



It has also been shown that thioid has only one form irrespective of the method of preparation. X-ray powder patterns and infrared spectra support this conclusion.

Methyl substitution in the 2 and/or 4 position in the piperazine ring does not alter the structure of the resulting substituted thioid, but the same substitution at the 1-position results in the formation of a salt which is structurally similar to the piperidine salt of piperidine-1-carbodithioic acid.

It is possible to titrate thioid as a weak acid with potassium hydroxide to give a conductance curve which shows two breaks indicating the formation of the mono- and the dipotassium salts of the compound. If the system is then allowed to equilibrate for a period of twenty-four hours, further addition of thioid results in no other reaction. If, however, the above system is not allowed to equilibrate, a reaction which could either be the result of the formation of a thiuram disulfide or the dissociation of the dimer into two molecules of the monomer is thought to occur. The former explanation is favored.

The reaction between thioid and various metal salts has also been investigated, and a number of metal-thioid compounds have been prepared. Analyses and conductimetric titration data are in accord with the postulate that these compounds are formed by the replacement of two hydrogens in thioid by two unipositive cations or by one dipositive cation.

Possible evidence of a change in the C=S absorption frequency in the infrared region in going from thioid to the metal-thioid compounds, which might be due to some coordination of the metal ions, was obtained. However, the disappearance of the S-H stretching band in these compounds is felt to be more significant and is taken as evidence that the bonding in these compounds is most probably ionic. Polarographic data obtained are also in accord with this conclusion.

Microfilm $2.75; Xerox $4.20. 80 pages.

SOME COORDINATION POLYMERS PREPARED FROM bis-(β-DIKETONES)

(Order No. Mic 61-1654)

Joon Suk Oh, Ph.D.
University of Illinois, 1961

A series of metal ion-bis-(β-diketone) polymers containing beryllium, copper (II), nickel (II), zinc (II) or cobalt (II) were prepared by using four different methods. Three structures were postulated on the bases of elementary analysis for the polymers prepared.

The thermal stability of the above polymers was studied by a relatively simple method utilizing a thermogravimetric balance. It was found that the thermal stabilities are related to the nature of the central metal atom and the ligands. The order of thermal stabilities is Be (II) > Cu (II) > Ni (II) > Zn (II) > Co (II). The polymers derived from bis-(β-diketones) in which a phenyl group is substituted for the methyl group are thermally more stable than the polymers derived from the corresponding unsubstituted bis-(β-diketones). Similarly, the polymers derived from bis-(β-diketones) containing a connecting link are thermally less stable than the polymers derived from the corresponding bis-(β-diketones) which have no connecting group.

Several attempts to prepare polymers containing copper (II) or nickel (II) with polymeric Schiff's bases derived from bis-(β-diketones) and ethylenediamine were made. The copper (II) polymer derived from polymeric Schiff's bases exhibits a markedly increased thermal stability.

Microfilm $2.75; Xerox $4.60. 87 pages.

DIMETHYLSULFOXIDE AS A SOLVENT IN COORDINATION CHEMISTRY

(Order No. Mic 61-1671)

Darel Kerr Straub, Ph.D.
University of Illinois, 1961

The use of dimethylsulfoxide as a solvent in coordination chemistry was investigated. Most perchlorate and nitrate salts of coordination compounds are very soluble in dimethylsulfoxide. Equivalent conductances and near infrared spectra of some coordination compounds were obtained.

Compounds of chromium, manganese, cobalt, mercury, lead and bismuth containing coordinated dimethylsulfoxide have been prepared and investigated. In all of these compounds, infrared data indicate that coordination takes place through the oxygen of the sulfoxide group, rather than the sulfur. Structures were assigned from physical measurements to most of these compounds.

Metathetical reactions between coordinated chloride and silver nitrate or a silver carboxylate have been carried out in dimethylsulfoxide. Thus, trans-dichlorobisethylenediaminecobalt(III) chloride reacts with silver acetate, butyrate, benzoate, cinnamate, or 4-isopropylcinnamate to yield the corresponding dicarboxylatobisethylenediaminecobalt(III) carboxylate. There is evidence that these compounds possess a cis configuration. Tribenzoatodiethylenetriaminecobalt(III) resulted from the reaction between trichlorodiethylenetriaminecobalt(III) and silver benzoate. A few nitrato complexes, for example, dinitratobisethylenediaminecobalt(III) nitrate, have been prepared by the use of silver nitrate; however, in many cases, coordinated dimethylsulfoxide was also present in the product. It appears that nitrate ion and dimethylsulfoxide have similar coordinating ability.

Some attention has been given to the stability of coordination compounds in dimethylsulfoxide. When iodopentamminecobalt(III) nitrate was heated in dimethylsulfoxide solution, three products were found: hexamminecobalt(III) ion, hexakisdimethylsulfoxidecobalt(II) ion, and a compound having the empirical formula, $CoI_3 \cdot 5$Dimethylsulfoxide. This last compound, which is also formed by the reaction of iodine on hexakisdimethylsulfoxidecobalt(II) iodide, is paramagnetic and contains Co(II), but its structure has not yet been determined. A spectrophotometric study of the reaction between trans-dichlorobisethylenediaminecobalt(III) perchlorate and dimethylsulfoxide indicated that more than one step was involved. The final product was cis-bisdimethylsulfoxidebisethylenediaminecobalt(III) chloride perchlorate. This was also the cation formed when excess silver perchlorate was added to trans-dichlorobisethylenediaminecobalt(III) perchlorate in dimethylsulfoxide solution.

Microfilm $2.75; Xerox $3.80. 70 pages.

STUDIES IN COPRECIPITATION

(Order No. Mic 61-2285)

Wilbur Paul Tappmeyer, Ph.D.
University of Missouri, 1961

Supervisor: Dr. E. E. Pickett

A procedure employing 8-Hydroxyquinoline (oxine), tannic acid, and thionalid as mixed chelating agents and using aluminum oxinate as the carrier precipitate has been used for some time for the concentration of trace quantities of cobalt, nickel, lead, zinc, copper, etc., prior to spectrographic determination. V. I. Kuznetsev and coworkers used purely organic substances such as β-naphthol, phenolphthalein, etc., as carrier precipitates for the coprecipitation of trace quantities of certain metals bound as chelates from aqueous solution. It was the purpose of this problem to study the factors influencing this type of coprecipitation with the hope of ultimately combining these factors into one unified mathematical formulation.

Preliminary investigations were made on eight common metal ions (including the ones listed above) using various combinations of chelating agents and carrier precipitates. The effect of varying concentrations of chelating agent was explored extensively for the oxinate system and was shown to have a large influence on the extent of coprecipitation of certain metal ions. The observation was also made that increasing the concentration of the trace metal by a factor of one thousand did not appreciably change the completeness of coprecipitation. Various techniques for the addition of the better carrier precipitates (aluminum oxinate, phenolphthalein, β-naphthol) to the aqueous medium containing the metal chelates indicated that the extent of coprecipitation was not highly dependent upon the method of getting the organic and aqueous phases into intimate contact. Furthermore, the percentage of coprecipitation was found to be highly dependent upon the pH of the solution.

As solvent extraction of metal chelates was known to respond in a similar fashion to the above factors, some preliminary direct comparisons between this type of coprecipitation and solvent extraction were made. In general metal chelates that were largely extracted by 5 ml. of CCl_4 were also largely coprecipitated by 0.25 gm. of phenolphthalein or β-naphthol. Those metal chelates which were very poorly extracted by the solvent were also coprecipitated to a very small extent. During this initial phase of the problem the quantities of metals were detected either by the emission spectrograph or by colorimetric methods. Four radioisotopes, Co-60, Cu-64, Cd-115, and Mo-99 were then singled out for more accurate data. Plots of the percentage extraction vs. pH and percentage coprecipitation vs. pH for Cu-64, Mo-99, and Co-60 and using 5 ml. CCl_4 and 0.25 gm. phenolphthalein respectively and a constant excess of oxine showed the extraction and coprecipitation plots practically superimposable.

As shown by many authors the sigmoid type extraction curves resulting when organic solvents extract metal chelates can be predicted on the basis of formulated equations involving the equilibrium constants of the metal chelates, the dissociation constants of the chelating agent, the distribution coefficients of the metal chelate and the chelating agent between the organic and aqueous phases, and the concentrations of chelating agent and hydrogen ions of the solution. To further explore the similarity between solvent extraction and coprecipitation of the above type, these formulated equations were extended, with some modifications, to the predicting of the percentage coprecipitation vs. pH curves. It was found that the curves thus predicted for Cu, Co, Zn, and Cd and at different levels of excess chelating agent were in good agreement with those experimentally determined. The pH value at half coprecipitation ($pH_{1/2}$) by the calculated curves and the experimental curves were tabulated for some twenty of the curves and showed a percentage deviation of 0.17 pH units. Thus it was concluded that the factors influencing coprecipitation are the same ones that effect solvent extraction and equations similar to those of solvent extraction can be formulated to predict results in coprecipitation.

Microfilm $2.75; Xerox $6.80. 142 pages.

HIGHER OXIDATION STATES OF SILVER

(Order No. Mic 61-2129)

Magdalena Usategui, Ph.D.
Louisiana State University, 1961

Supervisor: Professor Joel Selbin

The use of ozone as an oxidizing agent to obtain higher oxidation states of silver has been investigated.

When ozone is bubbled through aqueous solutions of simple silver salts, black compounds of silver in higher oxidation states are formed. A study has been made to establish the composition, structure and stability of the black precipitates.

All available soluble silver salts whose anions are not oxidized by ozone: silver nitrate, silver sulfate, silver perchlorate, silver acetate and silver fluoride were reacted with ozone in aqueous solutions. The compositions of the precipitates formed were determined to be, respectively, $Ag_7O_8NO_3$, $Ag_7O_8SO_4$, Ag_4O_5, AgO and AgO.

Chemical analysis, determination of oxidizing power and infrared spectral data were used to establish their composition. X-ray powder diffraction studies were used to characterize the structure of the compounds.

A spinel type of structure similar to magnetite, Fe_3O_4, has been proposed for the products obtained which contain part of the silver in an oxidation state higher than two.

An attempt was made to substitute other divalent cations for the silver (II) ion in the precipitates obtained from the nitrate, sulfate and perchlorate solutions. Precipitates were obtained containing some Cd^{++} but in amounts too small to make conclusive statements.

Varying the time of ozonization had no influence on the composition of the products obtained.

Studies of the room temperature stability of the oxidized products obtained from silver nitrate, silver sulfate and silver perchlorate solutions showed that the stability drops off in the order given with the last being very unstable. It is suggested that the presence of $AgNO_3$ and $AgSO_4$, respectively, in the first two confers added stability which is lacking in the third, which does not contain $AgClO_4$.

Magnetic susceptibility measurements have given variable results for the molar susceptibilities of these compounds. It is suggested that the phenomenon being observed is not normal paramagnetism but rather ferrimagnetism or possibly antiferromagnetism. Chemical analyses and x-ray data established the same composition and structure for compounds of variable molar magnetic susceptibilities.

A search was made to find new ligands which would stabilize silver (II) but it was not successful. Ozone and potassium peroxydisulfate were used as oxidizing agents.

The preparation of four new silver (I) complexes is reported. They are: Bis-(benzalethylenediimine) silver (I) nitrate, Bis-(2 pyridinaldazine) silver (I) nitrate, tetrakis (triphenylphosphine) silver (I) perchlorate and tetrakis (triphenylarsine) silver (I) perchlorate.

Microfilm $2.75; Xerox $5.60. 112 pages.

CHEMISTRY, ORGANIC

THE BAEYER-VILLIGER OXIDATION OF BICYCLIC KETONES

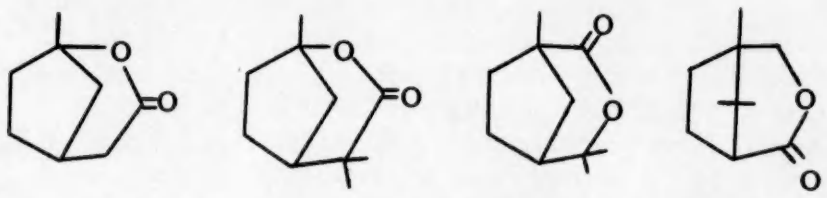
(Order No. Mic 61-2171)

George Patrick Ahearn, Ph.D.
Rutgers University, 1961

Major Professor: Ronald R. Sauers

A study of the peracid oxidation of ketones in the bicycloheptane system was made; and the structures of the various lactone products were established. The results led to some conclusions concerning the relative importance of the electronic effects in the alkyl migration, and the stereochemistry of the hydroxyperester intermediate, to the over-all mechanism.

1-Methylnorcamphor gave one lactone (I) in both buffered and acid media. Fenchone (1,3,3-trimethylnorcamphor) gave approximately a 50:50 mixture of two lactones, II and III. The instability of lactone III in the acid media gave inconclusive results concerning the product composition when the reaction is acid-catalyzed. Epicamphor (4,7,7-trimethylnorcamphor) gave only one lactone, β-campholide (IV), in buffered media.



I II III IV

These results were compared with those previously reported for norcamphor (2,2,1-bicycloheptane-2-one) and camphor (1,7,7-trimethylnorcamphor). The conclusions were that norcamphor systems not substituted at the carbon-7 position were particularly sensitive to the electronic effects of the migrating alkyl groups. Exception to this was noted when a gem-dimethyl group was situated at the carbon-7 position. Here, the steric effects of the boat or chair conformations of the lactone in the transition state become increasingly important. In fact, this is the controlling factor in the outcome of the peracid oxidation of epicamphor. Microfilm $2.75; Xerox $3.60. 62 pages.

UTILIZATION OF ALKYL ISOBUTYL KETONES IN THE PFITZINGER REACTION

(Order No. Mic 61-1384)

Kenneth William Bartz, Ph.D.
The University of Texas, 1959

Supervisor: Henry R. Henze

A series of alkyl isobutyl ketones (alkyl = methyl through amyl as well as isobutyl and isoamyl) was synthesized through the appropriate dialkylcadmium reagent and isovaleryl chloride. For each of these ketones two solid derivatives were prepared, namely a semicarbazone and

a hydantoin. The boiling point, index of refraction and per cent yield of each of the ketones, as well as the melting points of the appropriate derivatives, are listed in tabular form.

This series of alkyl isobutyl ketones was condensed with isatin under "Modified Pfitzinger Conditions." It has been reported elsewhere[1] that condensations of isatin with unsymmetrical ketones result in the formation of two isomeric cinchoninic acids. In the present study, however, the isolation of isomeric cinchoninic acids was realized only in the condensation of isatin with 4-methyl-2-pentanone. And, of the two isomeric cinchoninic acids thus produced (2-isobutylcinchoninic acid and 2-isopropyl-3-methylcinchoninic acid), the monosubstituted cinchoninic acid was obtained in the greater yield.

The proof of structure of three of the cinchoninic acids obtained under the conditions of the Pfitzinger Reaction was successfully accomplished through a "Modified Döbner Pyruvic Acid Synthesis." Thus, from the condensation of isatin and 4-methyl-2-pentanone and monosubstituted cinchoninic acid obtained was identified as 2-isobutylcinchoninic acid. This independent synthesis involved the condensation of aniline, isovaleraldehyde and pyruvic acid.[2] An independent synthesis of 2-isobutyl-3-methylcinchoninic acid, from the interaction of aniline, isovaleraldehyde and α-ketobutyric acid, was successfully accomplished, this acid was found to be identical with the cinchoninic acid isolated from the condensation of isatin and 5-methyl-3-hexanone. Similarly, the structure of the cinchoninic acid obtained from the interaction of isatin and 2-methyl-4-heptanone was determined to be 3-ethyl-2-isobutylcinchoninic acid.[3] From this sequence of reactions it is argued that (with the exception of 4-methyl-2-pentanone) the condensation of isatin with alkyl isobutyl ketones involves only the methylene group of the alkyl radical, in preference to the methylene group of the isobutyl radical. Therefore, from the interaction of isatin and alkyl isobutyl ketones the following cinchoninic acids were obtained:

ketone used	cinchoninic acid obtained
4-methyl-2-pentanone	2-isobutylcinchoninic acid and 2-isopropyl-3-methylcinchoninic acid
5-methyl-2-hexanone	2-isobutyl-3-methylcinchoninic acid
2-methyl-4-heptanone	3-ethyl-2-isobutylcinchoninic acid
2-methyl-4-octanone	2-isobutyl-3-propylcinchoninic acid[4]
2-methyl-4-nonanone	3-butyl-2-isobutylcinchoninic acid
2,6-dimethyl-4-heptanone	2-isobutyl-3-isopropylcinchoninic acid[5]
2,7-dimethyl-4-octanone	2,3-diisobutylcinchoninic acid.

Several of the cinchoninic acids synthesized in this study were decarboxylated to form quinolines (which were usually not isolated) from which picrates were formed. The picrates reported herein are those of 3-isopropyl-2-methylquinoline, 2-isobutyl-3-methylquinoline, 2-isobutyl-3-propylquinoline and 2-isobutyl-3-isopropylquinoline.

During the investigation of the interaction of aniline, isovaleraldehyde and α-ketobutyric acid, two crystalline modifications of 5-isobutyl-4-methyl-1-phenyl-3-phenylimino-2-pyrrolidone were isolated. It was found that the higher melting form of this pyrrolidone could be converted into the lower melting form. The interaction of aniline, isovaleraldehyde and α-ketovaleric acid resulted in the isolation of 4-ethyl-5-isobutyl-1-phenyl-3-phenylimino-2-pyrrolidone.

1. v. Braun, Gmelin and Schultheiss, Ber., 56, 1344 (1923).
2. Döbner, Ann., 242, 280 (1897), prepared a hydrated 2-isobutylcinchoninic acid through the interaction of aniline, isovaleraldehyde and pyruvic acid under similar conditions.
3. Buu-Hoï, et al., J. Org. Chem., 18, 1209 (1953), isolated a cinchoninic acid from the condensation of isatin and 2-methyl-4-heptanone under similar conditions and tentatively, but without rigorous proof, assigned to it the structure of 3-ethyl-2-isobutylcinchoninic acid.
4. Buu-Hoï, et al., ibid., reported the isolation of a cinchoninic acid from the interaction of isatin and 2-methyl-4-octanone and tentatively assigned to it the structure of 2-isobutyl-3-propylcinchoninic acid.
5. Buu-Hoï, et al., J. Chem. Soc., 1948, 106-110, reported failure in attempts to isolate a cinchoninic acid from the condensation of isatin and 2,6-dimethyl-4-heptanone.

Microfilm $2.75; Xerox $5.40. 108 pages.

STUDIES OF CERTAIN FLUORINE-CONTAINING ALKYL BROMIDES

(Order No. Mic 61-2457)

Robert Dean Battershell, Ph.D.
Purdue University, 1961

Major Professor: E. T. McBee

Part I

2-Trifluoromethyl-2-bromopropane was synthesized by the reaction of α-bromoisobutyric acid with sulfur tetrafluoride. The tertiary bromide is unreactive toward both magnesium-magnesium amalgam and phenylmagnesium bromide.

Part II

Grignard reagents were prepared from trifluoromethyl bromide, trifluoromethyl iodide, and heptafluoropropyl iodide by reaction of the halide with magnesium-magnesium amalgam. The reagents were characterized by their reaction with acetone.

Trifluoromethyl iodide was added to cyclohexene, at atmospheric pressure, and at room temperature in the presence of magnesium amalgam.

Part III

The rates of reaction of a number of polyfluoroalkyl halides with potassium or sodium iodide in acetone were determined and are shown on the following page.

Alkyl Halide	10^5°k (liter·mole^{-1}sec.$^{-1}$) 20°	35°	115°	160°	E_a (K.cal.)
$CH_3CH_2CH_2Br$	97.2	447			18.2
$CF_3CH_2CH_2Br$	16.6	90.3			20.3
$C_3F_7CH_2CH_2Br$	14.0	73.3			19.8
CF_3CH_2Br		0.0708	125	2500	22.2
$C_3F_7CH_2Br$		0.00581	17.6	433	23.8
CH_2=CH-CH_2Cl	12.9	60.6			18.5
trans-CF_3-CH=CH-CH_2Cl	68.8	358			19.9

The deactivating influence of the alpha and beta perfluoroalkyl groups is discussed in terms of steric and inductive effects.

Microfilm $2.75; Xerox $6.60. 137 pages.

RATES OF REACTION OF CYCLOPROPYL AND PHENYL SUBSTITUTED KETONES WITH SODIUM BOROHYDRIDE: KETONE REACTIVITY AS A MODEL FOR CARBONIUM ION STABILITY.

(Order No. Mic 61-2459)

Ralph Bernheimer, Ph.D.
Purdue University, 1961

Major Professor: Herbert C. Brown

The keto group has been utilized as a model for the carbonium ion to study the effect of the cyclopropyl and phenyl groups on the stability of carbonium ions. The empirical rule that the rate of reduction of a ketone varies inversely with the rate of solvolysis of the corresponding carbinyl ester derivatives was found to hold in these systems.

The rates of reduction of cyclopropyl methyl ketone, dicyclopropyl ketone, and by sodium borohydride in isopropanol were studied. The relative rates at 25° were found to be isopropyl methyl ketone, 1.00, diisopropyl ketone 0.0373, cyclopropyl methyl ketone, 0.0631, and dicyclopropyl ketone, 0.000932.

The relative rates were consistent with expectations based on steric and electron-releasing properties of the cyclopropyl group. Comparison of the data with earlier work on methyl isopropyl ketone and diisopropyl ketone indicated that the replacement of a cyclopropyl group for an isopropyl group α to a keto group resulted in a 16 fold decrease in the reduction rate while the replacement of two cyclopropyl groups for isopropyl groups had an additive effect on the rate of reduction. The results were consistent with the theory that a cyclopropyl group exhibits a strong tendency to release electron density to an electron-deficient center.

For the effect of a phenyl group, while Winstein and co-workers found that the order of solvolysis rates in acetic acid at 50° for the first two members of the 1-phenyl-2-propyl system was 1,1-diphenyl-2-propyl-p-Bromobenzenesulfonate > 1-phenyl-2-propyl p-bromobenzenesulfonate, we have determined that 1,1,1-triphenyl-2-propyl p-bromozenesulfonate ≫ 1,1-diphenyl-2-propyl p-bromobenzenesulfonate; for the analogous ketone reductions in isopropanol at 50°, the order was found to be 1-phenyl-2-propanone > 1,1-diphenyl-2-propanone ≫ 1,1,1-triphenyl-2-propanone. A plot of log k (solvolysis) vs. log k (borohydride reduction was found to be linear in this series. All the results are consistent with the theory of "F" and "B" strain, and a general discussion of carbonium ions is given in the light of the above results.

During the study of 1-p-methoxyphenyl substituted-2-propanone, it was determined that the reduction order of 1-p-methoxyphenyl-2-propanone, 3-p-methoxyphenyl-2-butanone and 3-methyl-3-p-methoxyphenyl-2-butanone by sodium borohydride in isopropanol was 1-p-methoxyphenyl-2-propanone > 3-p-methoxyphenyl-2-butanone > 3-methyl-3-p-methoxyphenyl-2-butanone. In the solvolysis of the corresponding p-methoxyphenyl substituted alkyl p-toluenesulfonate esters in dry acetic acid, Winstein and co-workers found that 3-p-methoxyphenyl-2-butyl tosylate is faster than 1-p-methoxyphenyl-2-propyl tosylate; we have determined that 3-methyl-3-p-methoxyphenyl-2-butyl tosylate was faster than 3-p-methoxyphenyl-2-butyl tosylate; these results were rationalized in terms of relief of "B" strain during the ester solvolysis and increases in "F" strain during the attack of sodium borohydride on the carbonyl carbon atom. However, whereas 1-p-methoxyphenyl-2-propyl tosylate solvolyzed 29 times faster than 1-phenyl-2-propyl tosylate, 1-p-methoxyphenyl-2-propanone and 1-phenyl-2-propanone were observed to reduce at the same rate. These results were interpretated in terms of extra effect which appeared in the solvolysis of the tosylate esters. This result was substantiated by a free energy plot (ester solvolysis vs. borohydride reduction reactions) of the phenyl substituted compounds and the p-methoxyphenyl substituted compounds which yielded two straight, almost parallel lines. These results were rationalized in terms of a bridging or participation phenomenon was important in the solvolysis of p-methoxyphenylalkyl tosylates in acetic acid.

Microfilm $3.70; Xerox $13.05. 286 pages.

PART I: SYNTHETIC APPROACHES TO TETRACYCLINES. PART II: MECHANISM OF THE REACTION OF CARBONYL CYANIDE WITH OLEFINS. PART III: ALKYLATION OF DIENAMINES.

(Order No. Mic 61-2204)

George Ignatz Birnbaum, Ph.D.
Columbia University, 1961

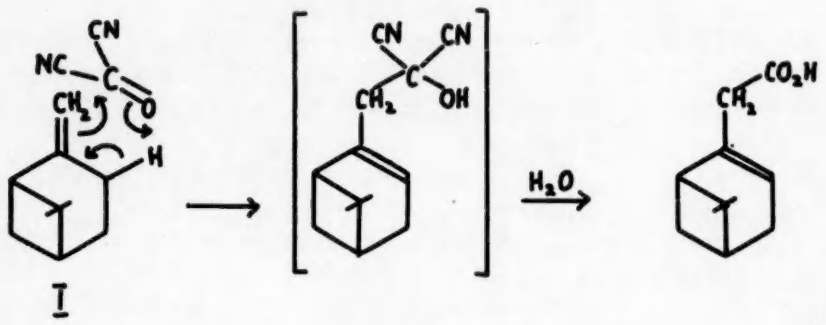
PART I: SYNTHETIC APPROACHES TO TETRACYCLINES

Possibilities were explored for using some quinone-imines and quinones as precursors of rings A and B of tetracyclines. γ-Resorcylic acid was partially methylated with diazomethane to give methyl 2-hydroxy-6-methoxybenzoate (I). I was coupled with benzene diazonium chloride and the resulting azo compound was hydrogenolyzed to give in small yield methyl 2-hydroxy-5-amino-6-methoxybenzoate.

Butadiene was added to methoxybenzoquinone to give 2-methoxy-4a, 5, 8, 8a-tetrahydronaphthoquinone (II). The carbonyl group in II which is not conjugated with the methoxy group was selectively reduced to the alcohol (III) with sodium borohydride. The p-toluene-sulfonate of III was prepared but attempts to displace the tosylate with diethylamine were not successful. The same carbonyl group in II was also selectively converted to an oxime, but it was impossible to reduce this oxime selectively to an amine.

PART II: MECHANISM OF THE REACTION OF CARBONYL CYANIDE WITH OLEFINS

In order to show that the title reaction does not have a carbonium ion in the transition state as had been suggested, carbonyl cyanide was added to β-pinene (I). The product, after hydrolysis, was mertenyl carboxylic acid (II). II was identified by esterification and subsequent reduction to an alcohol (III). The p-nitrobenzoate of III was identical with that of nopol. α-Pinene yielded a different acid which, however, was not isolated. On this basis the following cyclic mechanism is proposed:



I

PART III: ALKYLATION OF DIENAMINES

The alkylation of several enamines of $\Delta^{1(9)}$-octalone-2 with methyl iodide was investigated. The methylation always took place in the 1-position of the ketone. The product was isolated by vapor phase chromatography and identified by comparing its dinitrophenylhydrazone with that of authentic 1-methyl-$\Delta^{1(9)}$-octalone-2. The morpholine enamine was found to give the highest yields. Dioxane was shown to be the best solvent, presumably because it is best able to solvate the charged transition state.

Microfilm $2.75; Xerox $4.60. 88 pages.

A STUDY OF THE KINETICS OF THE REACTIONS OF THE CHLOROPYRIDINES AND THE CHLOROPYRIDINE N-OXIDES WITH SODIUM METHOXIDE IN METHANOL

(Order No. Mic 61-2176)

Robert Jacob Boxer, Ph.D.
Rutgers University, 1961

Major Professor: Dr. Roderick A. Barnes

The synthesis of picolinamide from picolinic acid was effected in 82% yield by substitution of liquid ammonia for ammonium hydroxide but otherwise following the Mixed Anhydride Procedure employed by Barnes and Godfrey.[1]

Atom localization energies of aromatic substitution in nitrosobenzene and the cyanopyridines were calculated by the method of Coulson.[2] These data were unsatisfactory to the extent that the little experimental data available did not permit an extensive comparison of calculated and experimental data.

The cyanopyridine N-oxides were prepared in good yield from the parent compounds by the use of perbenzoic acid in chloroform. When the 2- and 4-cyanopyridines were treated with peracetic acid at 75°, picolinamide N-oxide and isonicotinamide N-oxide were produced.

A self-absorption correction curve was experimentally obtained for silver cyanide labeled with carbon-14 with the purpose in mind of determining the rates of exchange between the cyanopyridines and potassium cyanide tagged with carbon-14. Investigation of the exchange rate of 4-cyanopyridine showed complete equilibration within seventeen minutes followed by a gradual loss of specific activity of the 4-cyanopyridine. This indicated that a side reaction with loss of radioactivity (presumably as cyanide ion) was taking place.

The rate constants of the reaction of the chloropyridines and the chloropyridine N-oxides with sodium methoxide in methanol were determined (Table I).

TABLE I

Reagent	Temperature	k(l./mole-hr.)
2-Chloropyridine	100°	.054
3-Chloropyridine	100°	.00146
3-Chloropyridine	120°	.0045
4-Chloropyridine	100°	.98
2-Chloropyridine N-Oxide	50°	2.09
3-Chloropyridine N-Oxide	50°	.00650
4-Chloropyridine N-Oxide	50°	2.99

On the basis of the preceding data and the atom localization energy calculations of pyridine N-oxide performed by Barnes,[3] a value of .6β was assigned for the resonance integral of the nitrogen-oxygen bond in the chloropyridine N-oxides.

References

(1) R. A. Barnes and J. Godfrey, J. Org. Chem. 22, 1043 (1947).

(2) C. Coulson, "Valence," pp. 238-256, Amen House, London, 1952.

(3) R. A. Barnes, J. Am. Chem. Soc., 81, 1935 (1959).

Microfilm $2.75; Xerox $5.00. 97 pages.

REACTIONS OF CERTAIN GRIGNARD REAGENTS OF SULFONES AND DISULFONES

(Order No. Mic 61-2310)

Edwin Taylor Boyd, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor Lamar Field

Reactions of p,p'-dichlorobenzophenone (I) with p-tolylsulfonylmethylmagnesium bromide (II) and with 1-(p-tolylsulfonyl)ethylmagnesium bromide (III) were studied. The refractory nature of I necessitated the use of conditions far more vigorous than usual for this type of reaction. The reaction of I with II gave 1,1-di(p-chlorophenyl)-2-p-tolylsulfonyl-1-ethanol (IV) which was dehydrated to 1,1-di(p-chlorophenyl)-2-p-tolylsulfonylethene (V). 1,1-Di(p-chlorophenyl)-2-p-tolylsulfonyl-1-propanol (VI) and its dehydration product, 1,1-di(p-chlorophenyl)-2-p-tolylsulfonyl-1-propene (VII), were prepared by a similar sequence involving reaction of I with III.

An unsuccessful attempt was made to isolate a diol adduct after reaction of the dimetalated derivative (X) of phenyl 2-hydroxy-2-phenylethyl sulfone (VIII) and benzaldehyde; the unexpected failure of this attempt suggests that VIII can be monometalated but that the product resists further metalation.

An investigation also was made of the preparation and reactions of di-Grignard reagents of disulfones of the series $ArSO_2(CH_2)_nSO_2Ar$. The simplest member of the series, 1,2-bis(phenylsulfonyl)ethane (XIII) did not form a stable di-Grignard reagent but instead underwent elimination reactions which were difficult to reproduce and gave a complex mixture of products, including ethyl phenyl sulfide (XIV) and probably n-butyl phenyl sulfone. The sulfide XIV probably resulted from reaction of ethylmagnesium bromide (XII) with benzenesulfinic acid (XVI), formed from the sulfone XIII by an elimination reaction. In a control experiment, XII and the acid XVI reacted to give crude XIV in 55% yield.

Gas evolution studies indicated that 1,3-bis(phenylsulfonyl)propane (XVII), 1,4-bis(p-tolylsulfonyl)butane (XVIII) and 1,5-bis(phenylsulfonyl)pentane (XX) were dimetalated by 8 moles of XII. A prolonged heating period resulted in elimination reactions.

The pentamethylene disulfone XX, when incompletely dimetalated by 2.5 moles of XII, gave in two reactions with I a 5% and an 11% yield of crude 1,1,7,7-tetrakis(p-chlorophenyl)-2,6-bis(phenylsulfonyl)-1,7-heptanediol (XXI). A similar reaction with acetone gave 2,8-dimethyl-3,7-bis(phenylsulfonyl)-2,8-nonanediol (XXII) in 16% yield. No other pure substances could be isolated, despite extensive efforts. Dimetalation of XX with 8 moles of XII followed by addition of 8 moles of bromine gave a 98% yield of crude 1,5-dibromo-1,5-bis(phenylsulfonyl)pentane (XXIII), from which one crystalline isomer was obtained in 8% yield. The remaining product which was probably a mixture of isomers could not be crystallized. A reaction between XX and 1.2 moles of XII and a limited amount of bromine did not produce an isolable monobromo derivative of XX.

This work suggests that di-Grignard reagents of disulfones are somewhat more difficult to prepare than Grignard reagents of monosulfones. Proper dimetalation apparently requires a considerable excess of XII, and under these conditions metalation does not take place in two distinguishable steps. These di-Grignard reagents seem to have limited synthetic potential because of the requirement of an excess of XII for metalation. Nevertheless, despite the low yields of adducts obtained when small excesses of XII are used for metalation, the difficulty of obtaining these products by other means makes the routes described the ones of choice, at least for the present.

Microfilm $2.75; Xerox $5.60. 114 pages.

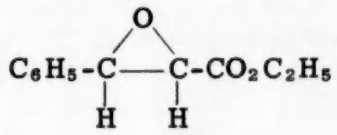
ALDEHYDES AND BASES IN THE DARZENS CONDENSATION

(Order No. Mic 61-2312)

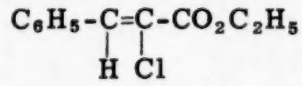
Clayton George Carlile, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor L. Field

The products obtained from the Darzens condensation of benzaldehyde and ethyl chloroacetate are ethyl phenylglycidate (I) and ethyl α-chlorocinnamate (II). The ratio of I to II is strongly influenced by the cation of the base used and the reaction medium. This ratio decreases in the sequence of the following cations: tetramethylammonium, potassium, sodium, lithium. Polar solvents give a higher ratio than non-polar solvents. With the exception of diglyme (dimethyl ether of diethylene glycol), all of the solvents examined give both I and II with the trans configuration at 0°. At higher temperatures (27-30°) and in the presence of a polar solvent, or with diglyme at 0°, what appears to be an azeotropic mixture of both cis- and trans-I is formed. The presence of trans-I in the mixture was definitely established. A mechanism to explain these data is suggested.

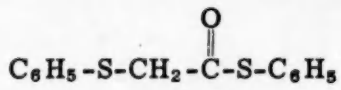


I



II

The yield of glycidic esters from aliphatic aldehydes is low owing to a competitive aldol condensation of the aldehyde. Demonstrating this point, propionaldehyde gives ethyl 2,3-epoxypentanoate in 12% yield and aldol products in 54% yield in the presence of ethyl chloroacetate and potassium t-butoxide. In an effort to increase the yield of the glycidic ester at the expense of the aldol, the use of a more active ester, phenyl α-chlorothiolacetate was examined. When benzaldehyde was used as a model carbonyl component, phenyl phenylthiothiolacetate (III) was the only product isolated; therefore, this approach was abandoned.



III

With the exception of formaldehyde which gave ethyl glycidate in 7-16% yield, aliphatic aldehydes containing no α-hydrogens (and thus inactive in self-aldolization reactions) give increased yields of the glycidate. Thus, the following previously unreported glycidates were prepared:

ethyl 2,3-epoxy-4,4-dimethylhept-6-enoate (17% yield from 2,2-dimethyl-4-pentenal); ethyl 2,3-epoxy-4,4-dimethylpentanoate (67% yield from pivaldehyde).

Infrared analysis suggests that p-nitrobenzylidine-p-anisidine reacts with ethyl chloroacetate in the presence of potassium t-butoxide in a manner analogous to carbonyl compounds to give the substituted ethyleneimine.

Microfilm $2.75; Xerox $3.60. 61 pages.

THE SYNTHESES AND PROPERTIES OF SOME BENZIMIDAZOLYL AMINO ACIDS

(Order No. Mic 61-2020)

Lawrence Anthony Cescon, Ph.D.
University of Pennsylvania, 1961

Supervisor: Allan R. Day

This investigation concerns the preparation of some homologues of 2-benzimidazolyl-α-alanine for subsequent examination as antimetabolites.

It has been shown herein that glutamic acid will condense with o-aryldiamines in 5.5 N hydrochloric acid to give good yields of the corresponding α-amino-γ-(2-benzimidazolyl)-butyric acids and that where an optically active glutamic acid is employed, the resulting benzimidazole α-amino acid is also optically active.

Further, if an o-aryldiamine and a β-(5-hydantoinyl)-propionic acid is employed in 4-6 N hydrochloric acid, a short reflux period (c.a. 18 hours) allows the intermediate benzimidazole hydantoin to be isolated whereas a long reflux (c.a. 72 hours) results in hydrolysis of this intermediate hydantoin and the corresponding benzimidazole α-amino acid is isolated.

The reaction of aspartic acid and o-phenylenediamine in 5.5 N hydrochloric acid gives three products: 2-benzimidazolyl-α-alanine, 2-benzimidazolyl-β-alanine, and vinylene-2,2'-bis-benzimidazole.

The use of monobasic amino acids with o-phenylenediamine in 5.5 N hydrochloric acid appears to give the following order of decreasing reactivity: β-alanine > glycine > α-alanine > α-amino-isobutyric acid. The β-alanine reaction appears nearly quantitative in 24 hours while α-amino-isobutyric acid appears for all practical purposes unreacted after 115 hours of reflux. This leads to the conclusion that increasing substitution in the α-position reduces the reactivity of the carboxyl functionality.

All the above reactions were observed by periodically running ascending paper chromatograms on the acid reaction mixture. Thus, the general technique involved observing in subsequent paper chromatograms the increase in product spot area and the decrease in o-aryldiamine spot area with reflux time. Effective separations were obtained by employing a solvent system of n-butanol (40) -acetic acid (10) -water (50). Detection was accomplished as follows: the benzimidazoles and o-aryldiamines were observable with a 2537 Å ultraviolet light; the amino acids with 0.1% ninhydrin-acetone solution gave violet colors (except 2-benzimidazolyl-α-alanine which gives a yellow spot); the 2-aminoalkyl benzimidazoles with ninhydrin gave yellow to violet colors; and o-aryldiamines, as o-phenylenediamine, gave yellow-green colors with ninhydrin. With these existing differences in detection, the need for standards in the paper chromatography often proved unnecessary.

Microfilm $2.75; Xerox $6.60. 137 pages.

THE CHEMISTRY OF PYRENE

(Order No. Mic 61-2363)

Yi-Han Chang, Ph.D.
The Pennsylvania State University, 1961

This dissertation was intended to be a comprehensive study of the chemistry of pyrene.

The three theoretically-possible monocarboxylic acids of pyrene were successfully synthesized by unambiguous routes. Comparison of the physical properties of the acids obtained in this laboratory with those reported in the literature indicated that the structural assignments of pyrene-1- and pyrene-2-carboxylic acids in use are correct. However, the material previously reported to be pyrene-4-carboxylic acid was shown to be a mixture of pyrene-1- and pyrene-4-carboxylic acids. A set of ultraviolet and infrared spectra of the isomeric acids was obtained.

The second phase of this research was concerned with the positions of attack by electrophilic, nucleophilic, and free-radical reagents upon the pyrene molecule. This investigation showed that electrophilic reagents and neutral free-radicals attack pyrene at the 1-position. These observations are in agreement with those reported in the literature. Metalations of pyrene with butyllithium or sodium in liquid ammonia and subsequent carbonation were shown, in disagreement with the literature, to produce two isomeric monocarboxylic acids of pyrene substituted at the 1- and 4-positions. Attempts to determine the position of attack by a nucleophilic reagent upon the pyrene molecule failed.

A number of alkylpyrenes, i.e., 1-decyl-, 4-decyl-, 2-hexyl-, 1-decylperhydro-, and 1-ethylpyrenes, were synthesized for physical property studies. The positions of the alkyl substituents were established by relating the hydrocarbons to the corresponding carboxylic acids. A set of ultraviolet and infrared spectra of these alkylpyrenes was obtained.

The hydrogenation of pyrene with copper chromite catalyst was studied. It was found that the products and their yields depend upon the concentration of the catalyst. With appropriate catalyst concentration, any hydropyrene (e.g., 4,5-dihydro-, 4,5,9,10-tetrahydro-, s-hexahydro-, as-hexahydro-, decahydropyrenes, or perhydropyrene) could be obtained in appreciable yield from the hydrogenation. A procedure for the complete separation of complex mixtures of hydropyrenes was developed. The ultraviolet and infrared spectra of the aforementioned hydropyrenes were obtained and are of value for identification purposes.

Microfilm $2.75; Xerox $7.00. 149 pages.

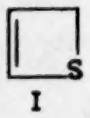
THE SYNTHESIS AND REACTIONS OF DERIVATIVES OF THIETANE AND THIETENE

(Order No. Mic 61-2022)

Marcia Elizabeth Christy, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Donald C. Dittmer

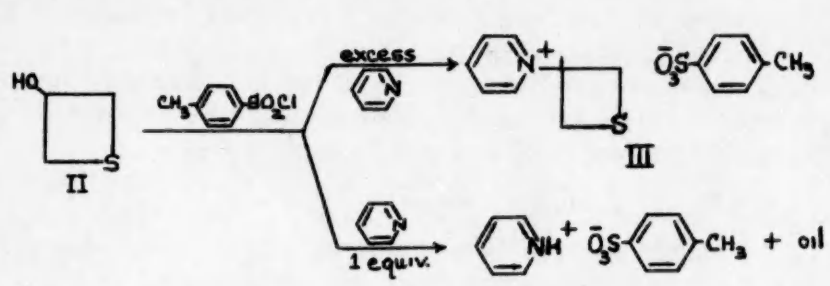
This research has consisted of a systematic investigation of some of the possible synthetic approaches to the unknown four-membered unsaturated sulfur heterocycle, thietene (I).



I

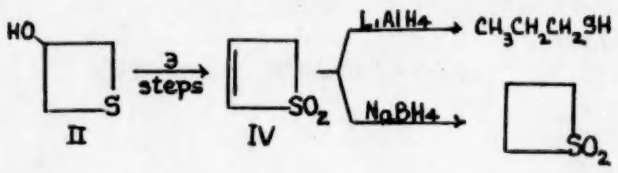
The investigation has been limited to routes based on 3-thietanol (II) as the starting material.

Direct dehydration of 3-thietanol (II) by several of the conventional methods failed to yield the desired thietene (I), but, in general, gave polymeric materials. Attempted conversions of II to intermediates suitable for elimination reactions also failed. Treatment of II with p-toluenesulfonyl chloride in excess pyridine afforded 3-pyridinium-thietane p-toluenesulfonate (III), and when the amount of pyridine was restricted to one equivalent, pyridine p-toluenesulfonate and an unidentified oil were isolated.



II III

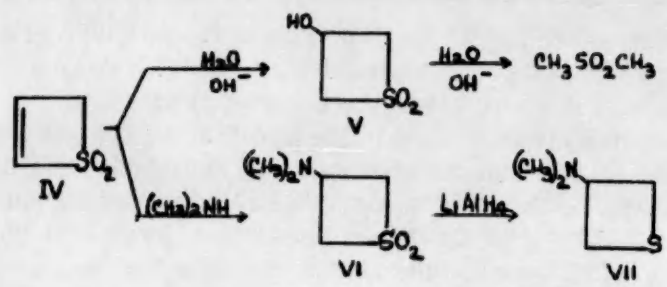
The first representative of a four-membered cyclic unsaturated sulfone, thietene sulfone (IV), has been synthesized conveniently from 3-thietanol (II). Reduction of this sulfone with lithium aluminum hydride yielded n-propyl mercaptan rather than the desired thietene (I). Reduction with sodium borohydride afforded trimethylene sulfone.



II IV

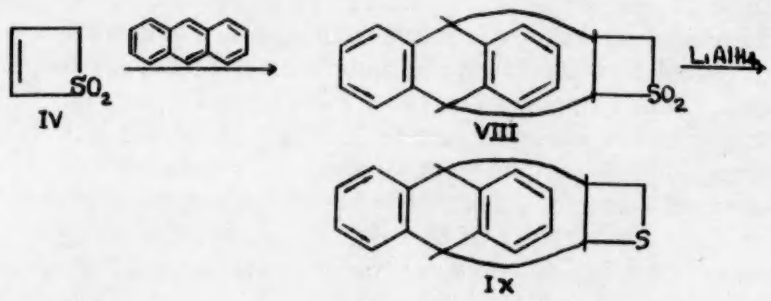
The double bond of IV facilely underwent addition of various nucleophilic reagents to yield derivatives of trimethylene sulfone. Addition of water in the presence of hydroxide ion proceeded through the intermediate 3-thietanol-1,1-dioxide (V) to yield dimethylsulfone. Addition of dimethylamine to IV gave 3-dimethylaminothietane-1,1-dioxide (VI) which, on reduction with lithium aluminum hydride, afforded the thietane derivative VII. Pyrolysis of the quaternary hydroxide prepared from VII failed to yield thietene (I).

The Diels-Alder adduct of thietene sulfone and anthracene (VIII) has been prepared and reduced with lithium aluminum hydride to the adduct of thietene, IX. Pyrolytic



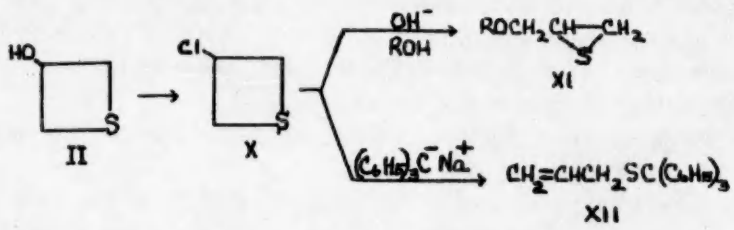
IV V VI VII

reversal of the Diels-Alder addition to afford the desired thietene (I) was unsuccessful.



IV VIII IX

Conditions for the dehydrohalogenation of 3-chlorothietane (X) to thietene (I) were not found. Treatment of X with tertiary amines gave low yields of amine hydrochloride indicative of an elimination reaction, but at the required temperatures caused extensive decomposition. Treatment of X with potassium hydroxide in alcohols apparently afforded alkoxyepisulfide derivatives (XI) and reaction with trityl sodium yielded allyl trityl sulfide (XII).



II X XI XII

Although the synthesis of the desired thietene (I) has not been realized in this research, new derivatives of thietene and thietane have been prepared and several avenues for further investigation have been opened.

Microfilm $2.75; Xerox $8.20. 178 pages.

THE SYNTHESIS OF SOME SUBSTITUTED PYRIMIDO (4,5-d) PYRIMIDINES.

(Order No. Mic 60-5382)

Michael Dymicky, Ph.D.
Temple University, 1960

Supervisor: Professor W. T. Caldwell

Cyclization of 4-amino-5-carbethoxy-2-mercaptopyrimidine with formamide has been accomplished, giving 4-hydroxy-7-mercaptopyrimido(4,5-d)dihydropyrimidine, which does not melt when heated up to 350°C.

It was found that the temperature is a critical factor in the condensation reaction. When the reaction mixture is heated for few hours at 140°C, or above, decarboxylation takes place and 4-amino-2-mercaptopyrimidine is obtained.

Heating below 110°C gives no reaction; however gradual increase of temperature from 110 – 140°C, over a period of about four days, gives the desired product.

An intermediate step in the cyclization reaction is the formation of a compound similar to Schiff base. This compound was isolated by heating the reactants for about two days at 110 – 130°C. It has been established that the formation of this compound is prerequisite for the cyclization reaction. The same procedure could not be adopted for the cyclization of 4-amino-5-carboxy-2-mercaptopyrimidine, since the unesterified carboxy group is much more labile.

The cyclized material obtained is desulfurized in water, using Raney nickel as desulfurizing agent, and 4-hydroxypyrimido(4,5-d)dihydropyrimidine monohydrate is prepared. This compound melts at 253°C and forms very strongly bound water of crystallization. It is easily soluble in water and decomposes in alkaline solutions. From this compound 4-amino-, 4-chloro- and 4-mercaptoderivatives have been prepared. All these compounds are insoluble in common organic solvents, decompose either in alkaline solutions or on heating above about 250°C, when in contact with air. In vacuum they sublime, except the 4-chlorocompound, at about 270°C/0.5 mm., which is the only method of purification so far discovered.

By pharmacological study it has been established that these 4-substituted pyrimido(4,5-d)pyrimidines do not have any effect against carcinoma, however they exhibit very high toxicity. Oral administration of small amounts of these compounds to an animal causes immediate death.

In connection with the study of cyclization, the new compounds 4-amino-5-carbethoxy- and 4-amino-5-carboxypyrimidine were prepared and a new bicyclic derivative of pyrimidine, 4-amino-5-carbethoxy-1,3-ab-imidazolopyrimidin, has been discovered.

No procedure for cyclization of these compounds with formamide could be developed.

Surprisingly it was interesting to see, that the new bicyclic derivative of pyrimidine is active against sarcoma 180.

4-Amino-5-carboxy compound is active against some fungi and a number of bacteria of the Staphylococcus aureus and Bacillus subtilis group.

A phenyl ureide of 4-amino-5-carbethoxy-2-mercaptopyrimidine and 2,4-diketo-7-mercapto-3-phenylpyrimido-(4,5-d)pyrimidine have been also prepared.

Microfilm $2.75; Xerox $4.60. 90 pages.

SYNTHESES AND REACTIONS OF IODONIUM SALTS

(Order No. Mic 60-4309)

Robert Allen Falk, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Professor F. Marshall Beringer

This dissertation reports the synthesis of numerous diphenyliodonium salts bearing nitro, alkyl, alkoxyl, acetoxyl, acetamido and amino substituents. 2,2'-Dithienyl- and phenyl-2-thienyliodonium salts have also been prepared, and their structures have been proved.

2-Phenoxyethanesulfonyl chloride was condensed with phenyliodosodiacetate, and the product was hydrolyzed to the betaine $4\text{-}C_6H_5\overset{+}{I}C_6H_4OCH_2CH_2SO_3^-$. The same sulfonyl chloride with iodine (III) trifluoroacetate gave a product which was hydrolyzed and isolated as a barium salt, $Ba^{++}/2\ 4,4'\text{-}\overset{+}{I}(C_6H_4OCH_2CH_2SO_3^-)_2$. As these materials do not contain the iodonium group in a cation, their aqueous solutions do not give precipitates with halide ions. Symmetrical and unsymmetrical salts were similarly obtained from phenoxyacetic acid. The structures of the iodonium cations were proved by their reactions with iodide ions to give 4-iodophenyl ethers, which were prepared independently.

Iodonium salts derived from benzene, substituted benzenes and thiophene have been allowed to react with numerous nucleophiles, including sulfite, 4-sulfophenoxide, sulfanilate, carbonate, cyanide, nitrite, thioglycollate and thioglyceroxide ion, the carbanion from dimedone, thiourea and tetramethylguanidine. Products were isolated and identified from several of these reactions which had hitherto been unreported.

Product distribution was studied in three types of competition reaction: a 4-nitro- or 4-methoxydiphenyliodonium ion with an excess of nucleophile; a 4,4'-dinitro- or 4,4'-dimethoxydiphenyliodonium ion competing with unsubstituted diphenyliodonium ion for an insufficiency of nucleophile; and two nucleophiles competing for an insufficiency of a symmetrical iodonium salt. Most analyses were performed by infrared spectrophotometry of the steam-distillable products dissolved in carbon disulfide.

The results are discussed in terms of two competing reactions: (1) direct nucleophilic displacement (favored by sulfite ion and 4-nitro substituents); and

$$Ar_2I^+\ X^- \longrightarrow ArX + ArI$$

(2) formation and reaction of a radical pair (the predominant reaction in the other cases studied).

$$Ar_2I^+\ X^- \rightleftharpoons Ar_2\dot{I}\ \dot{X} \longrightarrow ArX + ArI$$

$$Ar_2IX \qquad ArI + Ar\cdot X\cdot \longrightarrow ArX$$

Present results do not foreclose the possibility of benzyne intermediates in reactions of stronger bases with iodonium ions.

Microfilm $2.75; Xerox $6.40. 133 pages.

THE STEREOCHEMISTRY OF SOME REACTIONS IN A BRIDGED POLYCYCLIC SYSTEM. THE STEREOCHEMISTRY OF SOLVENT-CAGE REACTIONS.

(Order No. Mic 61-793)

William Charles Firth, Jr., Ph.D.
University of Colorado, 1960

Supervisor: Professor Stanley J. Cristol

A 2-substituent, X, in the aldrin system (5,6,7,8,9,9-hexachloro-1,2,3,4,4a,5,8,8a-octahydro-1,4-exo-endo-5,8-dimethanonaphthalene) is capable of endo-exo isomerism.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The steric relationship between X and Y when X is replaced by Y provides a clue to the mechanism of the substitution process.

The strong tendency for exo attack on a free intermediate in such ring systems is well known. This thesis reports a study of several reactions in which an appreciable fraction of the attack occurs endo. The combination within the solvent cage in which they form of two fragments from an original molecule is postulated as an important reaction path in all of these reactions. The formation of significant amounts of the endo epimer is then understandable from the energetics of such reactions and Hammond's rule.

The strong tendency for exo attack on a free radical in this system was confirmed by the decomposition of the endo- and exo-diacyl peroxides in bromotrichloromethane; the resulting bromide contained no detectable amount of the endo epimer.

The Hunsdiecker reaction in this system has been studied extensively by Krall (Ph.D. Thesis, University of Colorado, 1956). Some of his products were analyzed using infrared and isotope-dilution techniques. The results indicated that a mixture of bromides containing approximately 31 per cent of the endo epimer was formed, and that the product composition was not measurably influenced by the presence of benzoyl peroxide, a free-radical inhibitor, or the configuration of the starting silver salt. The results were interpreted on the basis of a cage reaction between an alkyl radical and a bromine atom.

The esters which formed in the diacyl peroxide decompositions discussed above could have formed by a solvent-cage combination of an alkyl and an acyloxy radical. If so esters of both the endo- and exo-alcohols should be formed by analogy with the Hunsdiecker reaction. It was found that the alcohol part of the ester was formed with essentially complete retention of configuration. Possible mechanisms are discussed.

The reaction of the endo- and exo-carboxylic acids with bromine and mercuric oxide was investigated. The reaction, believed to be new, proceeds by replacement of the carboxyl group with a bromine atom. The mixture of bromides was the same as that formed in the Hunsdiecker reaction of the corresponding silver salts. An acyl hypobromite intermediate is suggested for both reactions.

When the exo-diacyl peroxide was decomposed in the presence of bromine, evidence was obtained for the formation of appreciable amounts of endo-bromide. An intermediate acyl hypobromite was postulated.

The endo- and exo-amines were prepared and deaminated in acetic acid. A mixture of the endo- and exo-acetates was formed. When the endo-nitrosoacetamide was decomposed in acetic acid the mixture of the endo- and exo-acetates was the same as that formed by deamination of the endo-amine. The solvent-cage combination of an alkyl carbonium ion and an acetate ion is postulated as an important process in these reactions.

Microfilm $3.40; Xerox $11.95. 262 pages.

I. POLYMERIZATION OF SOME CYCLIC, NON-CONJUGATED DIOLEFINS. II. AN ATTEMPTED SYNTHESIS OF AN ETHYLENE-ANTHRACENE COPOLYMER.

(Order No. Mic 61-1617)

Robert Ziolkowski Greenley, Ph.D.
University of Illinois, 1961

I. Polymerization of some Cyclic, Non-Conjugated Diolefins

The possibility of transannular polymerizations of three cyclic, non-conjugated diolefins with symmetrically positioned double bonds was investigated. 1,4-Cyclohexadiene, 1,5-cyclooctadiene, and 1,6-cyclodecadiene were the monomers studied.

A new method of synthesis of 1,6-cyclodecadiene through the dimethylsulfoxide elimination reaction of 1,6-cyclodecyl-bis-(p-bromobenzenesulfonate) was demonstrated.

A Ziegler-type catalyst system with a low aluminum triisobutyl to titanium tetrachloride ratio was employed as the initiator for these polymerizations. 1,4-Cyclohexadiene gave a polymer identical to poly-1,3-cyclohexadiene. 1,5-Cyclooctadiene was readily polymerized to a bicyclo (3.3.0) octane type of ring system in the polymer backbone. A small amount of low molecular weight polymer was formed in a polymerization of 1,6-cyclodecadiene. This polymer is thought to contain a recurring perhydronaphthalene type of ring system in the polymer backbone.

II. An Attempted Synthesis of an Ethylene-Anthracene Copolymer

The synthesis of a series of 9,10-dihydroanthracene derivatives leading to 9,10-dihydro-9,10-bis-(methobromide)-anthracene is reported. The isolation of the cis-trans isomers of these derivatives is also described.

The dehydrohalogenation of 9,10-dihydro-9,10-bis-(methobromide)-anthracene by trimethylamine leads to the unstable monomer 9,10-dihydro-9,10-dimethyleneanthracene which, in the presence of oxygen, leads to a terpolymer of oxygen, ethylene, and anthracene.

Attempts to synthesize the polymer using either the Hofmann pyrolysis of 9,10-dihydro-9,10-bis-(dimethylaminomethyl)-anthracene dimethobromide or the Wittig reaction on anthraquinone or 10-methyleneanthrone were unsuccessful.

Microfilm $2.75; Xerox $4.80. 91 pages.

THE PREPARATION AND PROPERTIES OF GLUCOSE-6-SULFATE

(Order No. Mic 61-1489)

Kenneth Balm Guiseley, Ph.D.
Syracuse University, 1960

Supervisor: P. M. Ruoff

Of four methods described for the direct sulfation of glucose, two have new modifications; one of these is

believed to be an improvement, from the over-all standpoint of speed of preparation, yield, and purity of product. In addition to the direct sulfation of glucose, two definitive syntheses of glucose-6-sulfate are described; one involving ammonolysis of the acetate groups from barium 1,2,3,4-tetra-O-acetyl-β-D-glucopyranose-6-sulfate, the other, the hydrolysis of the benzylidene groups from barium 1,2;3,5-di-O-benzylidene-α-D-glucofuranose-6-sulfate. Purification of the mixture obtained by direct sulfation was accomplished by column chromatography, but neither this, nor either of the unequivocal syntheses, was well suited to the production of gram quantities of glucose-6-sulfate. A three-fold recrystallization of the brucinium salt obtained from the direct sulfation mixture gave brucinium glucose-6-sulfate of 98 mole per cent purity. This degree of purity was sufficient for conversion to a readily crystallizable potassium salt, for which some X-ray data were obtained.

A preliminary investigation was made on unpurified glucose sulfate to screen certain nitrogenous bases, chosen for one reason or another, for their potential catalytic effect on the hydrolysis of sulfate.

Kinetic studies on the hydrolysis of the pure potassium salts of glucose-6-sulfate and ethyl sulfate were made, adapting the recently reported colorimetric determination of sulfate ions with barium chloranilate.

Although glucose-4-sulfate obtained by ammonolysis of barium 1,2,3,6-tetra-O-acetyl-β-D-glucopyranose-4-sulfate was not pure, a synthetic route was established for further work. Attempts to prepare glucose-4,6-sulfate met with less success, and none could be prepared by either of two cyclizing methods or by direct sulfation with sulfuryl chloride.

Microfilm $3.00; Xerox $13.50. 232 pages.

THE KINETICS OF OXYGEN EXCHANGE OF SUBSTITUTED BENZYL ALCOHOLS AS A FUNCTION OF ACIDITY

(Order No. Mic 61-1342)

David Austin Jeffrey, Ph.D.
University of Arkansas, 1961

Major Professor: Arthur Fry

Reactions involving the benzyl system are frequently considered to lie in the borderline region between the pure S_N1 and S_N2 mechanistic classifications (1). One of the important methods which has been used to gain information about these borderline reactions is to study the effect of changing a ring substituent on the rate of a chemical reaction (1). In an ideal case a given reaction might be shifted from the S_N1 extreme to the S_N2 extreme simply by changing the ring substituent from p-methoxy to p-nitro. The acid-catalyzed exchange of water with substituted benzyl alcohols is a very desirable reaction to study in this respect since the ideal S_N2 transition state or intermediate would be completely symmetrical.

Furthermore, to the extent that the Zucker-Hammett hypothesis (2) is valid, study of the exchange reactions as a function of acidity should provide a clear cut distinction between an S_N1 (A-1) case and an S_N2 (A-2) case. According to this hypothesis, an A-1 reaction will be characterized by a linear relationship between $-H_o$ and log k_1 whereas an A-2 reaction will show a linear relationship between log C_{H^+} and log k_1.

Accordingly the rates of exchange of oxygen-18 enriched unsubstituted, p-methoxy-, p-methyl-, p-chloro- and p-nitrobenzyl alcohols with water were measured as a function of the sulphuric acid concentration of the reaction medium. It was later found that the rate of exchange of the oxygen-18 enriched p-nitrobenzyl alcohol was inconveniently slow compared with that of the other compounds, and as a result, a detailed kinetic study was not made.

In each case exchange studies were made at two different temperatures for 0.5 M sulphuric acid and the results were used in calculating the Arrhenius activation energy and entropy of activation. The results of these calculations are shown in Table I.

Table I

Values of E and ΔS at 25° for the Acid-Catalyzed Oxygen Exchange of Benzyl Alcohols

Alcohol	$k_{ex} \times 10^8$ at 25° (sec^{-1})	E (kcal/mole)	ΔS	$k_{ex} \times 10^5$ at 100° (sec^{-1})
Anisyl	12,000	22.0	-5.2	21,000
p-Methylbenzyl	47.6	24.5	-6.8	171
Benzyl	5.61	25.8	-7.1	3.62
p-Chlorobenzyl	2.43	26.0	-8.2	1.66

The data in Table I show that the relative rates of the acid-catalyzed oxygen exchange of para-substituted benzyl alcohols is in the following order: $CH_3O > CH_3 > H > Cl > NO_2$. In view of the fact that the electron-donating groups in the para position have an accelerating influence on the rate one may conclude that the benzyl carbon is more positive in the transition state than in the reactant alcohol. Further, the rate of exchange is proportional to h_o (over the range of acidities studied) for each of the above compounds, which shows clearly that the conjugate acid of the alcohol is the reacting species. Thus, to the extent that the Zucker-Hammett hypothesis is valid, all of these compounds react by an A-1 mechanism.

However, the entropy of activation data above suggest that the exchange reaction becomes increasingly more S_N2 like as the electron donating power of the substituent decreases (3,4). Further, the observed positive curvature of a Hammett sigma-rho plot of the data suggests that the reaction is taking on increasing A-2 (S_N2) character as the elctron-donating power of the substituent increases, which may be indicative of a unity of mechanism for this particular reaction as has been proposed by Swain and Landsdorf (1) for the reactions of substituted benzyl alcohols.

An alternate expression of the relationship between rate constant and acidity for the A-2 type reaction is

$$\log k/a_{H_2O} = -H_o + \log \frac{f_s f_{BH}}{f_{\ddagger} f_B} + \text{constant}$$

and it is proposed that the linearity of a plot of log k/a_{H_2O} versus $-H_o$ is more clearly diagnostic of the A-2 mechanism

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than is the supposed linearity of a plot of log k versus log C_{H^+}. Examples from the literature in support of this idea have been presented since the acidity range (0.1 to 2.0 M) used in this work was not sufficiently wide to provide an adequate test.

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Microfilm $2.75; Xerox $5.60. 112 pages.

THE REACTION OF TRIPHENYLTIN HYDRIDE WITH THE ACETYLENIC BOND

(Order No. Mic 61-2146)

Neil Vance Kern, Ph.D.
University of Minnesota, 1961

Adviser: O. H. Johnson

It was found that triphenyltin hydride reacts with the acetylenic bond in phenylacetylene to form trans-2-phenylvinyltriphenyltin. Infra-red and proton nuclear magnetic resonance spectra as well as steric considerations indicate the structure is that of trans-2-phenylvinyltriphenyltin. This structure was verified through the independent synthesis of this compound by the reaction of β-styrylmagnesium bromide with triphenyltin chloride.

A new compound, 2-(2-pyridyl)ethyltriphenyltin, was prepared by the reaction of triphenyltin hydride with 2-vinylpyridine. The structure of this compound was determined from its infra-red spectrum.

Microfilm $2.75; Xerox $3.60. 62 pages.

THREE STUDIES IN THE OXIDATION OF ORGANIC SULFUR COMPOUNDS

(Order No. Mic 60-4426)

Leonard Sidney Levitt, Ph.D.
Temple University, 1953

Part I – A New Method for the Quantitative Determination of Thiophene in the Presence of Organic Sulfides.

The purpose of this investigation has been to develop a new method for the quantitative determination of thiophene, particularly in the presence of aromatic sulfides. It was felt that such a method should prove rather useful as a supplement to the widely used procedure of Ball, which, in the determination of various type sulfur constituents of petroleum products, makes no differentiation between aromatic sulfides and thiophenes, but precipitates them together as the mercuric nitrate derivatives.

The present method consists simply of refluxing the thiophene-containing sample with 8 to 16 N nitric acid, which oxidizes the sulfur to sulfuric acid. The resulting sulfate is then precipitated as barium sulfate in the usual manner and weighed as such.

From the results obtained in the analysis of twenty samples of solutions of thiophene in benzene and in cyclohexane, containing 1.85% S, it was calculated that the probable error of any single determination is about 2.5%, whereas a widely used colorimetric method is subject to a 15 to 30% error.

Experiments carried out in the presence of diethyl sulfide and diphenyl sulfide show that aliphatic and aromatic sulfides do not interfere, but other sulfur-containing compounds which might by oxidation give rise to sulfuric acid should be absent. Nor does oxalic acid, previously reported as an oxidation product of thiophene, interfere in the determination.

Evidence available from this investigation and from previous work indicates that most thiophene derivatives are oxidized to sulfate by nitric acid. This fact strongly suggests that the present method might very well be applicable to the quantitative determination in petroleum distillates of thiophene and its derivatives as a single group.

In addition to its greater accuracy, other advantages of the new method are the simplicity of the equipment required, and the applicability of the method to colored and turbid solutions.

Part II – Products of the Oxidation of Thiophene by Nitric Acid.

It was considered of interest to attempt to discover something of the nature of the intermediate products and by-products of the oxidative decomposition of thiophene by nitric acid.

The reaction between the aqueous nitric acid solution and the solution of thiophene in cyclohexane was interrupted at an intermediate stage, and the aqueous phase separated and analyzed.

2-Nitrothiophene was isolated from the mixture by steam distillation. 2,5-dinitrothiophene was obtained by extraction with ether and identified by a special color test previously reported. Maleic acid was obtained by further ether extractions of the aqueous solution and its identity confirmed by preparation of an anilide derivative. Oxalic acid was crystallized directly from the remaining water solution by cooling the solution after evaporating it to a smaller volume.

A kinetic run carried out using a homogeneous solution of nitric acid and thiophene in dioxane and water at 65° revealed that all the thiophene is converted to an intermediate compound before any of it is completely decomposed to sulfuric acid.

All of the available evidence indicates that the organic products identified in the reaction mixture arise during the course of the reaction in the order stated above.

A spectrophotometric method for the quantitative determination of 2,5-dinitrothiophene has been developed. This method depends on the formation of the deep blue color obtained when a trace of the nitro compound is dissolved in an alkaline acetone solution.

Part III – A Kinetic Study of the Persulfate Oxidation of Some Sulfoxides in Buffered Solution

By studying the kinetics of the oxidation of sulfides and sulfoxides it was hoped that an insight into the mode of oxidative attack at a sulfur atom would be gained, as well as some knowledge of the mechanism by which persulfate reacts.

The kinetics of the persulfate oxidation of water, diphenyl sulfoxide, thiodiglycol sulfoxide, diethyl sulfoxide, and diethyl sulfide were investigated at 60° and 80° in buffered aqueous solutions of pH 8.0 and ionic strength 0.5. The rate of disappearance of potassium persulfate was followed by iodometric titration. The reactions all were first-order with respect to persulfate. With the various substrates present the velocity of the reaction increased in the order in which the compounds are listed.

Diethyl sulfone and thiodiglycol sulfone were isolated as oxidation products. Diethyl sulfide was oxidized to the sulfoxide at an immeasurably fast rate and thereafter to the sulfone at a rate identical with that observed for diethyl sulfoxide.

At sulfoxide-persulfate molar ratios less than one a point of inflection was observed in the first-order plots when diethyl sulfoxide or thiodiglycol sulfoxide (but not diphenyl sulfoxide) were used. The second portion of these reactions was interpreted as a further oxidative attack on the sulfone molecule, possibly at the alpha-C.

Activation energies were calculated for the reaction of persulfate with water and with the three sulfoxides. The value for water (32 kcal.) was considerably higher than the values for the sulfoxides (24-25.5 kcal.).

It was observed that atmospheric oxygen had no effect on the rate. This was considered as evidence against a radical-chain type mechanism.

With diethyl and diphenyl sulfoxides a limiting rate was attained at a certain substrate concentration, above which no further increase in concentration resulted in an increased rate. Thus the reaction is independent of sulfoxide concentration over a wide range.

An empirical equation of the form, $k = aS_o/(b + S_o)$, relating the rate constant, k, to the initial sulfoxide concentration, S_o, was developed for these two cases.

A mechanism of an ionic and molecular type, involving two equilibrium steps and a final irreversible step, was proposed. It is assumed that the persulfate ion dissociates reversibly into a sulfate ion and a molecule of sulfur tetroxide. The latter substance is also considered to combine reversibly with the substrate to form an activated complex. The final step, the irreversible hydrolysis of the complex to give the final products, is assumed to be rate-determining.

Rate equations showing the rate dependence on initial sulfoxide concentration were derived from the proposed mechanism in agreement with the observed data. The final rate equation, of the same form as the above empirical equation, and showing also the inhibitory effect of sulfate, was

$$\text{rate} = \frac{k_3 K_1 [H_2O] [R_2SO]_o [S_2O_8^{=}]}{[SO_4^{=}] (K_{-2} + [R_2SO]_o)} .$$

Microfilm $2.75; Xerox $6.60. 139 pages.

STEREOCHEMISTRY OF THE DIELS-ALDER REACTION

(Order No. Mic 61-1997)

James Grubbs Martin, Ph.D.
Princeton University, 1960

Interest in the stereochemistry of the Diels-Alder reaction has continued to increase since the initial correlations of Alder and his co-workers in the 1930s. Various configurational generalities have been enunciated by Alder, including the principles of "cis-addition," "quasicyclic conformational requirement for acyclic dienes," "endo-addition" and the approach of dienes from the exo-side of dienophiles related to norbornene. The importance of steric effects in directing the latter two stereochemical results is examined in some detail and emphasized herein as being of comparable magnitude to the currently accepted effects of secondary electronic attractions. It appears that steric effects are likewise involved to a significant extent in determining the preferred structural orientations of adducts.

It is shown that configurational and structural results of Diels-Alder reactions can be correlated most effectively using a description of the primary transition state based upon the mono-bonded reaction intermediate detected by Woodward and Katz. A qualitative evaluation of the electronic and steric allowances at various substituent locations is presented, and these ideas are illustrated with pertinent examples in an extensive literature review.

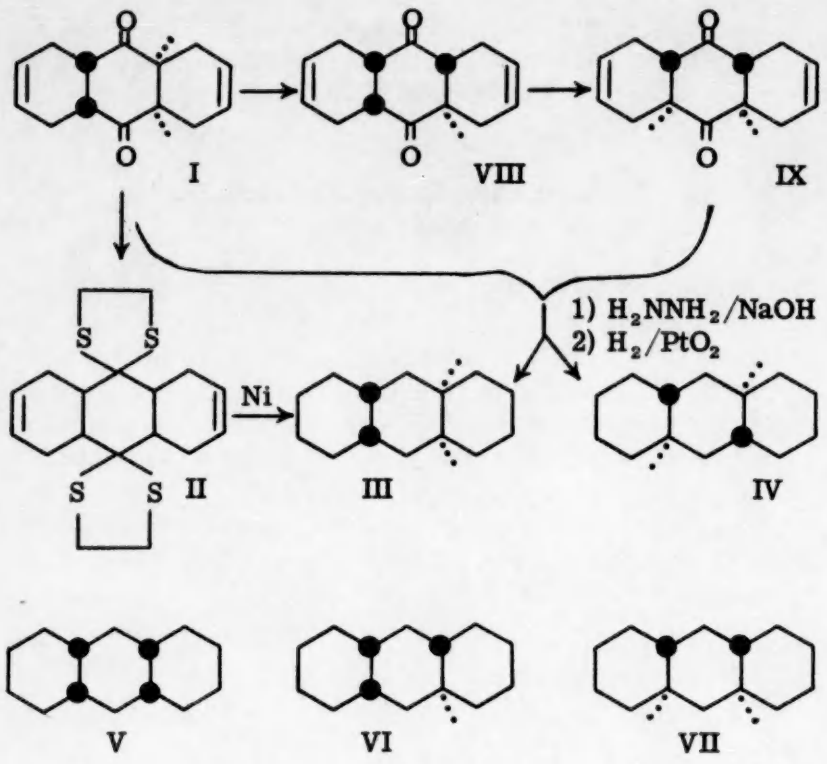
It was recognized that the stereochemistry of the bis-butadiene-quinone adduct I should be determined by steric control, such that the two diene components approach from opposite (or anti) sides of the quinone plane. Alder and Stein had established that each ring-junction was cis-fused but were unable to distinguish experimentally between the cis, syn, cis and cis, anti, cis alternatives.

In the present work the cis, anti, cis assignment has been demonstrated, by converting the adduct to the bis-ethylene thioketal II which was simultaneously desulfurized and hydrogenated to a new perhydroanthracene III, m.p. 124°, by Raney nickel in boiling ethanol. The lack of isomerization of the ring-junctions during this Wolfrom reduction is supported by closely analogous experiments. Of the five theoretically possible stereoisomers of perhydroanthracene, III – VII, the cis, syn, cis-V, m.p. 63°, cis, trans-VI, m.p. 40°, and trans, syn, trans-VII, m.p. 93°, had been previously reported and characterized. It is concluded, therefore, that I and III are cis, anti, cis.

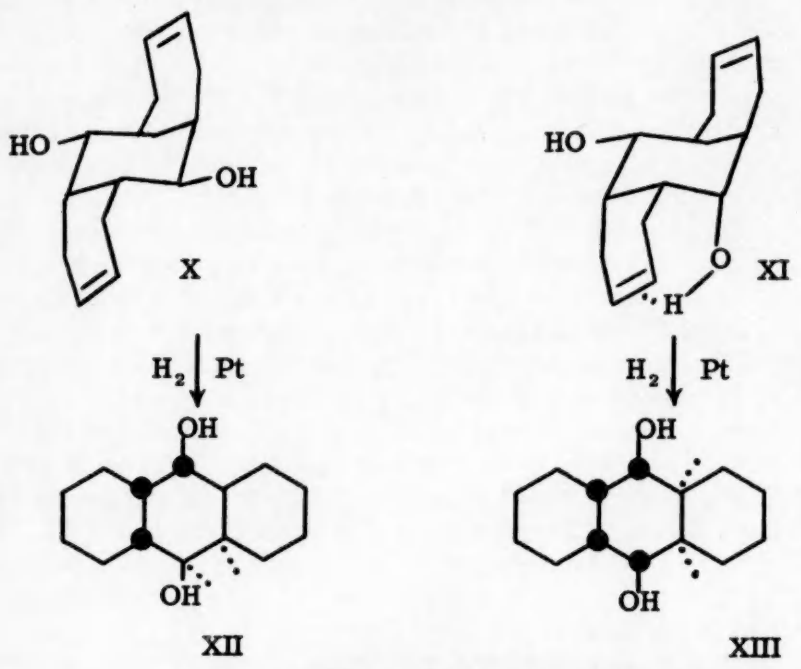
Huang-Minlon reduction of the adduct, followed by catalytic hydrogenation, yielded the new hydrocarbon III, and, unexpectedly, the remaining trans, anti, trans-perhydroanthracene IV, m.p. 46°. It was subsequently found that similar treatment of either of the known isomeric ketones VIII and IX, formed by isomerization of the adduct I, leads to the same mixture of III and IV. The significance of this stereoselective result is discussed.

It was found that the infrared spectra of these hydrocarbons in carbon tetrachloride were diagnostically different. Nuclear magnetic resonance spectra in chloroform of all except cis, syn, cis were also measured, and are discussed briefly.

Sodium borohydride reduction of I gave two epimeric dialcohols X, m.p. 259°, and XI, m.p. 136°, which were hydrogenated to XII, m.p. 276.5°, and XIII, m.p. 175°,



respectively. The configurations of these diols were established by infrared analysis in the hydrogen-bonded OH stretching region. While the higher melting diol X and both tetrahydro diols, XII and XIII, showed only free OH peaks, the low melting XI exhibited both a free OH peak and an intramolecularly bonded peak. That the bonded peak is not present in XIII indicates that the hydrogen bonding in XI involved one of the side-ring double bonds.



Microfilm $3.30; Xerox $11.50. 255 pages.

SOME CONDENSATIONS AND RELATED REACTIONS OF MONO- AND BIS-ACETYLFERROCENES

(Order No. Mic 61-1447)

Thompson Arthur Mashburn, Jr., Ph.D.
Duke University, 1961

Supervisor: Charles R. Hauser

Treatment of mixtures of bis-acetylferrocene and benzaldehyde with 5% aqueous-ethanolic sodium hydroxide produced a yellow product and a red product, which were evidently mono- and di-benzaldehyde derivatives respectively. The structure of the red product was established as the di-benzal derivative of bis-acetylferrocene but that of the yellow product was not determined. Some evidence was obtained that the latter compound had a cyclic vinyl ether structure.

Acylations at both of the methyl groups of bis-acetylferrocene with esters by potassium amide in liquid ammonia to form bis-β-diketones appears to be quite general. Unsuccessful attempts were made to isolate the corresponding mono-β-diketones, which might be expected as intermediates. The bis-β-diketones were reacted with excess hydrazine to form bis-pyrazoles. A cyclic mechanism for the diacylations is suggested.

The methyl group of mono-acetylferrocene was alkylated with benzyl chloride by means of potassium amide to form the dibenzylation product. Attempts to isolate the intermediate mono-benzylation product were unsuccessful. Evidence was obtained that the second benzyl group was introduced into the molecule more rapidly than the first. Similarly the two methyl groups of bis-acetylferrocene were alkylated with benzyl chloride by potassium amide to form the tetrabenzylation product. No intermediates were isolated. These alkylations furnish more convenient methods of syntheses of the corresponding di- and tetra-benzylation products than certain methods that were devised in connection with the proof of their structures. Certain theoretical aspects are considered. The results are compared with the benzylation of acetophenone under the same conditions.

Mono-acetylferrocene was condensed with formaldehyde and dimethylamine hydrochloride or diethylamine hydrochloride to form Mannich type salts, which were converted to the free amines and to acryoylferrocene. One of the salts was cyclized with phenylhydrazine to form a pyrazoline. One of the free amines was hydrogenated to give the hydroxyamine.

The reduction of mono-benzoylferrocene with sodium borohydride in methanol solution produced the methyl ether of 1-hydroxybenzylferrocene, rather than the expected hydroxybenzylferrocene. Treatment of bis-(1-hydroxyethyl) ferrocene, obtained by the reduction of bis-acetylferrocene with lithium aluminum hydride, with 2% acetic acid in ethanol-water produced the corresponding cyclic internal ether.

Microfilm $2.75; Xerox $5.00. 99 pages.

PREPARATION OF STEREOSPECIFIC POLYMERS THROUGH A CYCLIC POLYMERIZATION MECHANISM

(Order No. Mic 61-2239)

W. Lamar Miller, Ph.D.
The University of Florida, 1961

Three areas of interest concerning the polymerization of diene monomers via a cyclic polymerization mechanism were investigated. These considerations are: 1) the relation of the structure of the monomer to the polymerizability of the monomer, 2) the determination of the existence of stereo regulation via this mechanism and 3) the investigation of the extent of this stereo regulation in a polymerization system.

A series of diallylamides, some of which had not been previously reported, were prepared and the physical constants of these compounds are listed. A structurally related compound, N,N-diallyl-N-tricyanovinylamine was also prepared. Included in this study was an investigation of the infrared spectra and the polymerizability of the diallyl substituted compounds. A correlation of the results of the polymerization study and infrared investigation is offered. This correlation is presented as substantiating evidence for an intramolecular interaction in the monomeric compounds which is believed to offer a partial explanation for the success of the accepted intramolecular-intermolecular cyclic polymerization mechanism.

Methacrylic anhydride was polymerized, in high yields, at temperatures ranging from 1° to 80° C., in benzene solution, to linear, soluble polymers. The poly-(methacrylic anhydride) so prepared was hydrolyzed to the corresponding poly-(methacrylic acid) and this poly-(acid) esterified by reaction with diazomethane to yield poly-(methyl methacrylate). The result of an x-ray diffraction study of an unstretched film of poly-(methyl methacrylate) prepared in a similar manner is given. The determination of the fraction of the polymer present in each of the three possible stereo configurations, isotactic, syndiotactic and heterotactic, was made from a nuclear magnetic resonance investigation of the derived poly-(methyl methacrylate). The results indicate that the stereo configuration is influenced by the cyclic polymerization mechanism. The results also indicate that there is a bias toward increasing isotactic character in the polymers with an increase in polymerization temperature. Two possible explanations are offered. One in terms of a kinetic control of the steric placements and the other in terms of a balance between equilibrium and kinetic considerations.

Microfilm $2.75; Xerox $3.60. 64 pages.

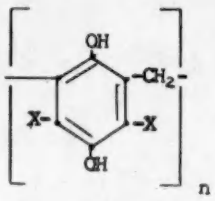
ELECTRON EXCHANGE POLYMERS FROM DISUBSTITUTED HYDROQUINONES AND FORMALDEHYDE

(Order No. Mic 61-390)

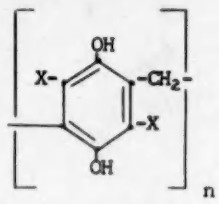
Richard Keith Quisenberry, Ph.D.
University of Utah, 1961

Chairman: William J. Burke

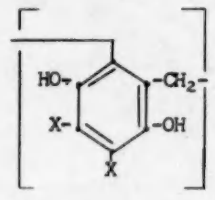
Linear, high molecular weight, electron exchange polymers, Ia, IIa and IIIa, were produced by heating 2,6-, 2,5- and 2,3-dichlorohydroquinone with s-trioxane in a closed system with bis-2-ethoxyethyl)ether as the solvent and p-toluenesulfonic acid monohydrate as the catalyst. The corresponding polymers Ib, IIb and IIIb, were obtained by the condensation of 2,6-, 2,5- and 2,3-dimethylhydroquinone with formaldehyde



(Ia: x=Cl)
(Ib: x=CH_3)



(IIa: x=Cl)
(IIb: x=CH_3)



(IIIa: x=Cl)
(IIIb: x=CH_3)

under similar conditions. The polymers, I, II and III, differed structurally in that the methylene bridges were located meta, para and ortho, respectively, with respect to each other.

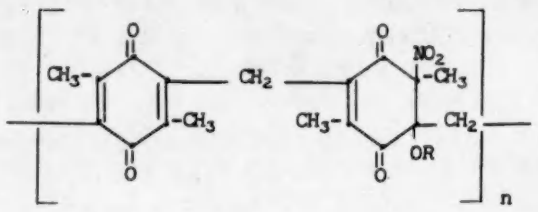
A study of reaction variables indicated that the use of a 50% molar excess of formaldehyde and the presence of sulfur dioxide favored formation of products of higher molecular weight. In addition, the relative amounts of solvent used in these condensations proved to be highly significant in determining both the degree of polymerization and solubility of the polymer. Reaction temperatures in excess of 130°C in the condensation of the dichlorohydroquinones with formaldehyde led to insoluble products, while soluble products were obtained with the dimethylhydroquinones at temperatures as high as 170°C.

The disubstituted hydroquinone-formaldehyde polymers were characterized by the preparation of acetyl derivatives, cryoscopic molecular weight determination, elemental and functional group analyses and infrared spectra. The analytical results indicated that during the condensations of the dichlorohydroquinones with formaldehyde 20 to 30% of the chlorine atoms were replaced by hydrogen. This conclusion was further supported by cross-linking and infrared studies.

It was demonstrated that these polymers could undergo reversible oxidation and reduction. Common oxidizing agents such as ferric chloride and manganese dioxide were found to easily convert the disubstituted hydroquinone-formaldehyde polymers to the polymeric quinhydrone derivatives. Sodium chlorate in dilute acid oxidized the dichlorohydroquinone-formaldehyde polymers to the corresponding reducible quinone polymers, which were characterized by elemental analysis and infrared spectra. Reaction with sodium hydrosulfite converted these oxidized polymers to products whose viscosities and infrared spectra were essentially those of the original polymers. In

addition, the quinhydrone polymers from both series were readily reduced.

Oxidation of the three dimethylhydroquinone-formaldehyde polymers with concentrated nitric acid resulted in nitrogen containing products. The structure (IV) was assigned these polymers on the basis of results obtained from elemental analyses, infrared spectra and the analysis of acetylated derivatives.



(IV)

Microfilm $2.75; Xerox $4.40. 83 pages.

CONDENSATION REACTIONS OF FLUORINATED COMPOUNDS

(Order No. Mic 61-2500)

Samuel Resconich, Ph.D.
Purdue University, 1961

Major Professor: E. T. McBee

Part I. The Reformatsky Reaction of Fluoroacetates with Magnesium Amalgam.

Ethyl chlorodifluoro-, difluoro- and trifluoroacetate were successfully condensed with fluorinated and non-fluorinated carbonyl compounds in the presence of a dilute magnesium amalgam to give α,α-difluoro-β-hydroxyesters. The reaction of ethyl difluoroacetate is novel in that this is the first reported instance of an ester not containing an active halogen undergoing a Reformatsky reaction. In these reactions ketones gave better yields, the yields decreasing in the order acetone > trifluoroacetone > aldehydes > trifluoroacetophenone > fluoroaldehydes. The lower yields, however, should not be ascribed to carbonyl or ester inactivity, since in many instances these reagents underwent side reactions, such as bimolecular reduction or aldol condensation, of which some are significant in the understanding of the amalgam reaction. Also, a higher condensation product was isolated in the reaction of trifluoroacetaldehyde with ethyl difluoroacetate. A mechanism is proposed for the amalgam reaction.

Part II. The Reaction of Ethylmagnesium Bromide with a Series of m- and p-Substituted Acetophenones and Trifluoroacetophenones.

A series of m- and p-substituted trifluoromethylacetophenones and methyl trifluoroacetophenones were prepared and treated with an escess of ethylmagnesium bromide at 0° under a nitrogen atmosphere. Two possible products can be expected in the reactions of each ketone with the Grignard reagent; namely the secondary and tertiary alcohols depending on whether addition or reduction occurs. For product identification purposes, these alcohols were obtained by different syntheses. The trifluoromethyl aryl ketones underwent heavy reduction with ethylmagnesium bromide to give a mixture of the secondary and tertiary alcohols; in the reaction of m- and p-trifluoromethylacetophenones with the same reagent, only the tertiary alcohols were obtained. These results demonstrate the inability of vinylogic inductive or resonance polar effects to influence the course of the Grignard reaction.

Microfilm $2.75; Xerox $8.00. 174 pages.

STUDIES DIRECTED TOWARD A DETERMINATION OF THE ABSOLUTE CONFIGURATION OF AN OPTICALLY ACTIVE DIPHENYL: THE SYNTHESIS OF 5-ACETAMINO-1,2,3,4-TETRAHYDRO-NAPHTHALENE-2-β-PROPANOIC ACID.

(Order No. Mic 61-2502)

Austin Julius Rich, Ph.D.
Purdue University, 1961

Major Professor: James H. Brewster

It seems desirable to establish a direct correlation of an optically active diphenyl to glyceraldehyde. The synthesis of a compound containing both an asymmetric carbon atom and a dissymmetric diphenyl linkage is essential to accomplish this correlation. 1,1'-Ditetralyl-2,2',4,4'-tetramino-7,7'-di-β-propanoic acid (I) appears suitable for the study. I contains both types of optically active centers and is relatable to simpler diphenyls and to glyceraldehyde. I can be related to 4,4',6,6'-tetranitro-2,2'-diphenic acid (II) by decarboxylation of the product obtained by oxidation of the 2,2',4,4'-tetranitro precursor of I. The use of 5-acetamino-1,2,3,4-tetrahydronaphthalene-2-β-propanoic acid (III) as an intermediate in the synthesis of I correlates I to glyceraldehyde since III can be converted to 1,2,3,4-tetrahydronaphthalene-2-β-propanoic acid (IV), a compound of known absolute configuration.

The synthesis of III was accomplished by the following sequence of intermediates: β-benzoylpropanoic acid, γ-phenylbutanoic acid, tetralone-1, tetralone-1-oxime, homodihydrocarbostyril, γ-(o-acetaminophenyl)-butanoic acid, 5-acetamino-1-tetralone, 2-(β-cyanoethyl)-5-acetamino-1-tetralone, 2-(β-carboxyethyl)-5-acetamino-1-tetralone, III. Hydrolysis and deamination converted III to IV, confirming the feasibility of employing III as a synthetic and stereochemical "relay" in the determination of the absolute configuration of II.

Microfilm $2.75; Xerox $4.00. 72 pages.

INTERMEDIATES IN THE SYNTHESIS OF RESERPINE

(Order No. Mic 61-2063)

Daniel David Rosenfeld, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Frederick V. Brutcher, Jr.

The γ-lactone of 2-carboxy-4-hydroxy-5-iodo cyclohexane-1-acetyl chloride, an intermediate which contains the correct number of carbon atoms, the necessary configurational relationship, and a point of attack for the attachment of ring E substituents for a reserpine molecule, has been synthesized.

Trans-Δ^4-tetrahydrohomophthalic anhydride, an intermediate which could be a stepping stone to a future synthesis of epiyohimbane derivatives, has also been successfully produced.

Precursory experiments into the condensation of both these intermediates with tryptamine have been shown to be extremely promising.

Microfilm $2.75; Xerox $4.60. 89 pages.

PART I: STUDIES OF THE DECOMPOSITION OF TETRASUBSTITUTED PHOSPHONIUM ALKOXIDES. PART II: COPPER ION-CATALYZED REACTIONS OF t-BUTYL PERBENZOATE WITH ALKYLBENZENES.

(Order No. Mic 61-2191)

Lawrence James Ross, Ph.D.
Rutgers University, 1961

Major Professor: Donald B. Denney

PART I

Although the formation of mixed hydrocarbons by the pyrolysis of tetraalkylphosphonium alkoxides is reported in the literature, it appears that this is in error or the reaction is limited to a relatively few systems.

Instead, tetra-n-butylphosphonium alkoxides preferably undergo simple dissociation reactions leading to tributylphosphine and an alkyl halide. Tetraphenylphosphonium alkoxides, even when heated as high as 320°, form no isolatable alkyl substituted benzenes.

Decomposition of tri-n-butyl-α-phenylethylphosphonium ethoxide gives a 15-21% yield of ethylbenzene when moisture is carefully excluded; little if any of the "mixed" hydrocarbon, sec-butylbenzene, is formed. This can be rationalized by the formation of the relatively stable α-phenylethyl carbanion which can abstract a proton from the solvent, ethanol.

PART II

A number of substituted toluenes were allowed to react with t-butyl perbenzoate in the presence of catalytic quantities of cupric 3,3,5-trimethylhexanoate, and the reaction products were examined for the appropriately substituted benzyl benzoate. It was found that low yields (less than 15%) were obtained when an electron-supplying group was absent. However, higher yields were obtained when the substituent was an electron-supplying group--thus p-methoxytoluene gave a 72% yield of anisyl benzoate. When this same reaction was run in the absence of the copper catalyst, the reaction rate decreased markedly, and the yield of ester fell to 23%.

An oxygen-18 tracer study was made of the catalyzed and non-catalyzed reactions of p-methoxytoluene with t-butyl perbenzoate labeled with oxygen-18 in the carbonyl position. The resulting ester was reduced with lithium aluminum hydride, and the alcohols were separated, derivatized, and analyzed for their oxygen-18 content. The results showed that only 50% of the original oxygen-18 was still in the carbonyl position of the ester. It was tentatively concluded that the catalyzed and non-catalyzed reactions proceed with complete equilibration of the perester's benzoyl ether and carbonyl oxygens.

The mechanistic implications of the above information are discussed and some reactions are suggested to clarify the oxygen-18 results.

Microfilm $2.75; Xerox $5.20. 105 pages.

THE MECHANISM OF DEOXYMERCURATION AND STRUCTURE OF MERCURIALS IN SOLUTION

(Order No. Mic 61-2156)

Larry Leroy Schaleger, Ph.D.
University of Minnesota, 1961

Adviser: Maurice M. Kreevoy

The mechanism of the non-halogen acid-catalyzed deoxymercuration of α-alkoxy-β-halomercury compounds is of interest because of the great ease with which the reaction occurs. Two aspects of the mechanism have been investigated, the influence of polar substituents on the rate and the relative stabilities in solution of the mercurials prepared from cis- and trans-2-butene.

The effect of polar groups, Y, on the rate of deoxymercuration of compounds of the type $YCH(OR)CH_2HgI$ has been evaluated by means of the Taft equation, $\log k/k_o = \rho^* \sigma^*$. Reaction constants, ρ^*, of -2.93 for $R=CH_3$ and -2.74 for R=H have been found, indicating considerable positive charge on the alpha carbon atom of the transition state.

The thermodynamic quantities of activation in the table have been calculated from rate measurements on the cis- and trans-2-butene adducts.

Compound	ΔH^+ (Kcal./mole^{-1})	ΔS^+ (e.u.)
Cis-Butene Adduct	14.8±0.3	-2.1
Trans-Butene Adduct	15.3±0.2	-3.5

The equilibrium constants of the reactions

$$CH_3CH{=}CHCH_3 + HgCl_2 \underset{}{\overset{H_2O}{\rightleftharpoons}} CH_3CH(OR)CH(CH_3)HgCl + H^+ + Cl^-$$

at 25° for both cis- and trans-2-butene have

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

been measured. For the cis-butene adduct, K_C is 4.5×10^{-4}; for the trans-butene adduct, K_C is 0.96×10^{-4}. Using the known free energies of formation of the olefins, it is shown that, in aqueous solution, the cis-butene adduct is more stable than the trans-butene adduct by 0.39 ± 0.12 kcal./mole^{-1}; and the transition state for oxymercuration-deoxymercuration in the cis series is more stable than that in the trans series by 0.5. kcal./mole. These results are interpreted in terms of rotational isomerism and dipole-dipole interactions.

Microfilm $2.75; Xerox $4.20. 80 pages.

NUCLEOPHILIC SUBSTITUTION IN HALOGENATED AROMATIC AND VINYLIC SYSTEMS

(Order No. Mic 61-2861)

John Andrew Sedlak, Ph.D.
The Ohio State University, 1960

This investigation was undertaken to fulfill the following purposes: (1) to broaden the range of aromatic and vinylic nucleophilic substitution by experimentation with a variety of nucleophilic reagents, such as fluoride, malonate, cyanide, or hydride ions, or electrons supplied by metals; (2) to explore the limits imposed on aromatic and vinylic nucleophilic substitution by the nature and number of activating groups; and (3) to demonstrate experimentally the differences in reactivity between fluorine-bearing and chlorine-bearing carbon atoms in aromatic and vinylic compounds and to explain these differences.

In the aromatic series, the preparation of 1-fluoro-2,4-dinitrobenzene by the reaction of 1-chloro-2,4-dinitrobenzene with potassium fluoride was improved by using N-methyl-2-pyrrolidone as solvent instead of nitrobenzene or dimethylformamide used by previous workers. Cesium fluoride and potassium acid fluoride were also tested as fluorinating agents, but dry powdered potassium fluoride proved most effective.

Reactions of activated aryl chlorides and fluorides with sodium diethyl malonate were carried out in N-methyl-2-pyrrolidone. At 50-55°, malonate substitutions were successful with 1-chloro-2,4-dinitrobenzene, 1-fluoro-2,4-dinitrobenzene, 1,3-difluoro-4,6-dinitrobenzene, and 1-fluoro-4-nitrobenzene, but unsuccessful with 1-chloro-4-nitrobenzene. The aryl fluorides were more reactive than the aryl chlorides because of the greater electron-withdrawing inductive effect of the fluorine atom.

In the vinylic series, CF_3- or $-CF_2$- groups and fluorine or chlorine atoms were used to activate vinylic halogens for nucleophilic attack. Potassium fluoride in dimethylformamide or N-methyl-2-pyrrolidone fluorinated $CF_3CCl{=}CClCF_3$ to $CF_3CCl{=}CFCF_3$ at 100° or to $CF_3CF{=}CFCF_3$ at 160°. Similar results were obtained with $\overline{CCl{=}CClCF_2CF_2CF_2}$. The greater difficulty of the second substitution was attributed to the high energies of the necessary reaction intermediates.

Vinylic fluorinations of $\overline{CCl{=}CClCF_2CF_2}$, $CF_3CH{=}CHCl$, $CF_3CH{=}CCl_2$, and $CF_3CCl{=}CCl_2$ were successful, although in some cases hydrogen fluoride addition formed saturated products besides the unsaturated products. Reactivity toward fluorination increased with chlorine accumulation in the vinyl system proper.

Reactions of sodium diethyl malonate with $CF_3CCl{=}CClCF_3$ or $CF_3CCl{=}CFCF_3$ in N-methyl-2-pyrrolidone gave $CF_3C(CH(COOC_2H_5)_2){=}CClCF_3$ only, showing that anionic attack replaces the vinylic fluorine preferentially.

Both chlorines of $CF_3CH{=}CCl_2$ were substituted by malonates, showing that anionic attack is possible on a negatively charged vinylic system. $\overline{CCl{=}CClCF_2CF_2CF_2}$ and $\overline{CF{=}CFCF_2CF_2CF_2}$ also gave disubstituted products, apparently through S_N2' reactions; product structures were postulated.

Lithium aluminum hydride reduction of $CF_3CCl{=}CClCF_3$ gave $CF_3CH{=}CHCF_3$ and $CF_3CCl{=}CHCF_3$, while $CF_3CCl{=}CFCF_3$ gave $CF_3CCl{=}CHCF_3$ as the major product. Therefore, the fluorine atom is substituted in preference to the chlorine atom. $CF_3CH{=}CHCl$ was reduced to $CF_3CH{=}CH_2$, even though only one CF_3 group and one Cl atom are available for activation of the vinylic system.

In N-methyl-2-pyrrolidone as solvent and proton-donating agent, iron powder reduced $CF_3CCl{=}CClCF_3$ to $CF_3CCl{=}CHCF_3$ at 200° and $CF_3CCl{=}CFCF_3$ to $CF_3CH{=}CFCF_3$ at 225°. The preferential reduction of chlorine is caused by the high energy of the intermediate necessary for fluorine reduction. Zinc dust also successfully reduced $CF_3CCl{=}CFCF_3$, but was not useful for reducing $CF_3CCl{=}CClCF_3$ because it promoted chlorine elimination to $CF_3C{\equiv}CCF_3$. Similarly, iron reduced $CF_3CCl{=}CCl_2$ to $CF_3CCl{=}CHCl$, but zinc caused elimination. $CF_3CH{=}CHCl$ was also reduced, but very sluggishly.

Zinc reduced $\overline{CCl{=}CClCF_2CF_2CF_2}$ to good yields of $\overline{CH{=}CClCF_2CF_2CF_2}$ and $\overline{CF{=}CFCF_2CF_2CF_2}$ to poor yields of $\overline{CH{=}CFCF_2CF_2CF_2}$, but iron was ineffective.

Qualitative results indicated that chlorine in $CF_3CCl{=}CClCF_3$ was substituted by cyanide ion from potassium cyanide, with N-methyl-2-pyrrolidone a more effective solvent than acetonitrile or acetone.

A side reaction during aromatic fluorination caused the discovery that 1-chloro-2,4-dinitrobenzene or 1-fluoro-2,4-dinitrobenzene reacts with dimethylformamide in the presence of potassium acid fluoride or anhydrous hydrogen fluoride to give high yields of N,N-dimethyl-2,4-dinitroaniline. A reaction sequence was proposed to explain these results.

In summary, the research gave good, new syntheses for perfluorinated olefins or fluorinated olefins containing chlorine or hydrogen. Also, methods for carbon-carbon condensation were explored and a simple, very effective method for preparing N,N-dimethyl-2,4-dinitroaniline was found. Microfilm $2.75; Xerox $6.20. 128 pages.

SYNTHESES AND CHARACTERIZATION OF SOME 3,4,5-TRIMETHOXYBENZOYL; 3,4,5-TRIMETHOXYBENZYL; AND 3,4,5-TRIMETHOXYPHENYLETHYL DERIVATIVES OF PIPERAZINE AND SOME RELATED COMPOUNDS.

(Order No. Mic 61-2242)

Bernard Silverman, Ph.D.
The University of Florida, 1961

The 3,4,5-trimethoxybenzoyl; 3,4,5-trimethoxybenzyl; and 2-(3,4,5-trimethoxyphenyl)ethyl derivatives of a number of amines (chiefly N-substituted piperazines) were prepared and a study was made of their modes of formation. Forty-six new compounds, which are to be evaluated as drugs, were synthesized and characterized during this study. Specific structures have been assigned to each of these new compounds. These structures were based on both chemical and physical evidence. In addition, an improved synthesis of 3,4,5-trimethoxybenzyl cyanide was developed in the course of this investigation.

A general procedure was developed for the preparation of the 3,4,5-trimethoxybenzamides by the reaction of 3,4,5-trimethoxybenzoyl chloride with amines. Eighteen of these compounds were prepared. In seventeen of these compounds, the amine from which the 3,4,5-trimethoxybenzamide was formed was an N-substituted piperazine. These N-substituents are methyl; 2-hydroxyethyl; phenyl; 2-tolyl; 3-tolyl; 4-tolyl; 2-chlorophenyl; 3-chlorophenyl; 4-chlorophenyl; (2-methyl-3-chloro)phenyl; (2-methyl-5-chloro)phenyl; (2-chloro-5-methyl)phenyl; (3-chloro-4-methyl)phenyl; 2-ethylphenyl; 2-methoxyphenyl; 2-ethoxyphenyl; and 2,5-dichlorophenyl. The other amine used was cyclohexyl amine.

The infrared spectra of these amides show carbonyl absorption of energy in the range 1610-1640 $cm.^{-1}$. This corresponds to a rather low energy for carbonyl absorption; however, one might expect this because of the electronic release of the 3,4,5-trimethoxyphenyl group which would be expected to lower the amount of double bond character in the carbonyl group.

A general method was also developed for the synthesis of 3,4,5-trimethoxybenzylamine hydrochlorides by the reaction of 3,4,5-trimethoxybenzyl chloride with amines. Nineteen 3,4,5-trimethoxybenzylamine hydrochlorides are reported. Eighteen of them were synthesized from N-substituted piperazines. These N-substituents are methyl; 2-hydroxyethyl; phenyl; 2-tolyl; 3-tolyl; 4-tolyl; 2-chlorophenyl; 3-chlorophenyl; 4-chlorophenyl; (2-methyl-3-chloro)phenyl; (2-methyl-5-chloro)phenyl; (2-chloro-5-methyl)phenyl; (3-chloro-4-methyl)phenyl; 2-ethylphenyl; 2-methoxyphenyl; 2-ethoxyphenyl; 2,5-dichlorophenyl; and 3-methylbenzyl. The preparation of N-cyclohexyl-3,4,5-trimethoxybenzylamine hydrochloride is also reported. The nineteen preceding compounds were characterized both as hydrochlorides and as free amines. One additional compound, N,N-dimethyl-N'-(3,4,5-trimethoxybenzyl)hydrazinium chloride was synthesized by the same general method as the preceding nineteen compounds.

The N-alkyl-N'-(3,4,5-trimethoxybenzyl)piperazines form dihydrochlorides under the experimental conditions, whereas the N-aryl-N'-(3,4,5-trimethoxybenzyl)piperazines form monohydrochlorides. These dihydrochlorides are very soluble in water; however, the monohydrochlorides are only slightly soluble in water. In general, the solubilities of the monohydrochlorides are about 4 g. per 100 ml. of boiling water and less than 1 g. per 100 ml. of water at room temperature.

Eight new N-substituted-N'-2-(3,4,5-trimethoxyphenyl)-ethyl piperazine hydrochlorides were prepared by a general procedure which involved the reaction of 2-(3,4,5-trimethoxyphenyl)ethyl chloride with N-substituted piperazines. These N-substituents are methyl; phenyl; 3-tolyl; 2-chlorophenyl; (2-methyl-5-chloro)phenyl; (2-chloro-5-methyl)phenyl; 2-ethoxyphenyl; and 2,5-dichlorophenyl. The hydrochlorides of the N-methyl-N'-[2-(3,4,5-trimethoxyphenyl)ethyl]piperazine dihydrochloride and the N-aryl-N'-2[(3,4,5-trimethoxyphenyl)ethyl]piperazine monohydrochlorides exhibit the same differences in water solubility as did the N-alkyl and N-aryl-N'-2-[(3,4,5-trimethoxybenzyl)piperazine] hydrochlorides.

A synthesis of 3,4,5-trimethoxybenzyl cyanide by the reaction of 3,4,5-trimethoxybenzyl chloride with sodium cyanide under S_N2 conditions was also developed. This affords an excellent method of preparing compounds for which 3,4,5-trimethoxybenzyl cyanide is an intermediate, such as 3,4,5-trimethoxyphenylacetyl chloride; 3,4,5-trimethoxyphenylacetamide; mescaline; and 2-(3,4,5-trimethoxyphenyl)ethyl chloride.

Microfilm $2.75; Xerox $4.20. 79 pages.

THE PREPARATION AND POLYMERIZATION OF SOME DIALLYL- AND DIMETHALLYLPHOSPHONIUM BROMIDES

(Order No. Mic 61-2244)

David Lloyd Skinner, Ph.D.
The University of Florida, 1961

Several 1,6-diunsaturated phosphonium bromides were synthesized by the reaction of the desired phosphine with any alkyl bromide. These materials were polymerized in solution using free radical initiators. The polymers obtained were soluble in ethanol and dimethylformamide in every case. The infrared spectra of the polymers indicated that they were free of unsaturation. This evidence supports the theory of intramolecular-intermolecular polymerization which was proposed to account for the production of linear polymers to the exclusion of cross-linked polymers from other 1,6-diene compounds. Two of the phosphonium bromide polymers were converted to phosphine oxide polymers by the action of sodium hydroxide. These phosphine oxide polymers were found to be identical with phosphine oxide polymers obtained by an alternate route. Intrinsic viscosity data obtained for both polyelectrolyte polymers and non-electrolyte polymers indicated that intrinsic viscosity gave very little indication as to the nature of the electrolyte polymers.

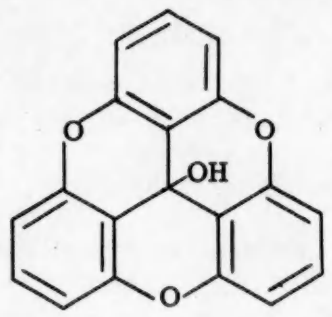
Microfilm $2.75; Xerox $3.60. 65 pages.

SESQUIXANTHYDROL AND RELATED COMPOUNDS

(Order No. Mic 61-1668)

Russell George Smith, Ph.D.
University of Illinois, 1961

Preparative routes to the following compounds are reported: 1-hydroxy-8-methoxyxanthone, 1,8-dimethoxyxanthone, 9-(2,6-dimethoxyphenyl)-1,8-dimethoxyxanthydrol and 2,6,2',6',2",6"-hexamethoxytriphenylcarbinol. In addition preparative routes to sesquixanthydrol, shown below, have been developed. The corresponding hydrocarbon and



chloride were also prepared and there is evidence that the hexaarylethane derivable from this ring system was also obtained. The ethane appears to be highly stable with only a slight amount of dissociation occurring in solution at room temperature.

Extensive studies were carried out on the triarylcarbinols, sesquixanthydrol, 2,6,2',6',2",6"-hexamethoxytriphenylcarbinol and 9-(2,6-dimethoxyphenyl)-1,8-dimethoxyxanthydrol. Sesquixanthydrol was found to be an exceptionally basic carbinol with pK_{R^+} of 9.05. It is believed that this basicity is due largely to resonance in the carbonium ion for which resonance structures involving the oxygen bridges may be written. The carbonium ion is thought to possess a planar configuration and it may be that this is a contributing factor to the high basicity of sesquixanthydrol.

The other two triarylcarbinols studied were also found to be very basic. It appears probable that release of steric strain on ionization of 2,6,2',6',2",6"-hexamethoxytriphenylcarbinol is an important factor in determining the basicity of this carbinol. It was found that basification of acid solutions of the 2,6,2',6',2",6"-hexamethoxytriphenylcarbonium ion did not regenerate the carbinol. This appears to be an excellent indication of the large degree of steric crowding about the central carbon atom of the carbonium ion.

Ultraviolet, visible and nuclear magnetic resonance spectra are reported for the three triarylcarbinols mentioned above and for the corresponding carbonium ions.

Microfilm $2.75; Xerox $5.40. 108 pages.

SYNTHESIS OF HYDROCARBONS FROM THIOPHENE DERIVATIVES

(Order No. Mic 61-1889)

Ilgvars Janis Spilners, Ph.D.
University of Pittsburgh, 1961

The purpose of this study is to find efficient ways to prepare alkylthiophenes and to convert these compounds to hydrocarbons.

The necessary thiophene derivatives, which were subjected to the desulfurization reactions, were prepared by (1) the acylation of thiophene and alkylthiophenes by means of acid anhydrides and carboxylic acids, (2) the Wolff-Kishner and Clemmensen reductions of the acylthiophenes thus prepared, and (3) the direct alkylation of thiophene and alkylthiophenes in liquid ammonia using sodium amide and alkyl halides.

The scope, limitations and the possible mechanism of the alkylation of thiophenes in liquid ammonia was studied. The method was found to be suitable for the preparation of simple 2-alkylthiophenes. Thus, 2-methylthiophene (66.5%), 2-ethylthiophene (52.0%), 2-n-butylthiophene (63.0%), and 2-n-hexylthiophene (55.5%) were prepared when a molar excess of sodium amide and a molar or greater excess of alkyl bromide over thiophene were used. However, alkylations of 2-alkylthiophenes gave relatively low yields of a mixture of 2,5-dialkylthiophene and 2-sec-alkylthiophene. Thus, methylation of 2-methylthiophene gave 2-ethylthiophene (5.0%) and 2,5-dimethylthiophene (27.0%); ethylation of 2-methylthiophene gave 2-n-propylthiophene (38.0%) and 2-ethyl-5-methylthiophene (5.0%); methylation of 2-ethylthiophene gave 2-ethyl-5-methylthiophene (13.0%) and a trace of 2-isopropylthiophene; ethylation of 2-ethylthiophene gave 2-sec-butylthiophene (29.0%) and 2,5-diethylthiophene (6.0%); ethylation of 2-n-butylthiophene gave 3-(2-thienyl)-hexane (9.0%) and a trace of 2-ethyl-5-n-butylthiophene. The formation of 2-thienylsodium and laterally-metalated 2-ethylthiophene in liquid ammonia by interaction of sodium amide and thiophene and 2-ethylthiophene, respectively, was shown by deuteration experiments.

To desulfurize and reduce thiophene derivatives Raney nickel and cobalt molybdate catalysts were used.

Desulfurization of alkylthiophenes (2-n-butylthiophene, 2-n-octylthiophene, 2,5-di-n-butylthiophene) using the Raney nickel catalyst gave from about 23 to 40 per cent yields of mixtures of the corresponding saturated and unsaturated hydrocarbons. Improved conditions were not found for replacing the large amount of the Raney nickel catalyst which is required to compensate for the poisoning effect of the thiophene compounds on the catalyst.

The cobalt molybdate desulfurization was found to take place through an initial saturation of the thiophene ring which was followed by the cleavage of the saturated ring, formation of a saturated hydrocarbon, and the removal of sulfur as hydrogen sulfide. With acylthiophenes (2-acetylthiophene, 2-propionylthiophene, and 2-ethyl-5-[(2-ethyl)-butyryl]thiophene) the reaction started with reduction of the carbonyl group. In the cobalt molybdate desulfurizations of alkylthiophenes yields as high as about 71 to 94 per cent of the corresponding saturated hydrocarbons were obtained. Thus, 2-ethylthiophene gave n-hexane (90.0%), 2-sec-butylthiophene gave 3-methylheptane (71.0%), 2-n-butylthiophene gave n-octane (85.0%), 2,5-di-n-butylthiophene

gave n-dodecane (94.5%), 2-ethyl-5-[(2-ethyl)-butyl]-thiophene gave 3-ethyldecane (74.3%), and 2,5-di-(n-propyl)-3-ethylthiophene gave 5-ethyldecane (93.0%).

Although a much higher reaction temperature and higher hydrogen pressure are required using the cobalt molybdate catalyst than when the Raney nickel catalyst is employed, the cobalt molybdate desulfurization, where the catalyst is not deactivated by sulfur, was found to give considerably higher yields of saturated hydrocarbons than when the Raney nickel catalyst is used.

Microfilm $2.75; Xerox $7.60. 165 pages.

PART I: THE STRUCTURE AND PROPERTIES OF ACID SOAPS. PART II: THE MICELLAR PROPERTIES OF ACID SOAPS IN AQUEOUS SYSTEMS.

(Order No. Mic 60-4427)

Samuel Spring, Ph.D.
Temple University, 1952

Abstract not available.

Microfilm $2.75; Xerox $6.80. 144 pages.

PREPARATION AND POLYMERIZATION OF CERTAIN DIUNSATURATED SILANES

(Order No. Mic 61-2245)

Robert William Stackman, Ph.D.
The University of Florida, 1961

The purpose of this research was to prepare a series of diunsaturated silanes, which are functionally capable of polymerizing by an intramolecular-intermolecular chain propagation mechanism, to polymerize these monomers and to study the resulting polymers.

A series of diallyl- and dimethallylsilanes were prepared by the reaction of allyl or methallyl Grignard reagents with the appropriate dichlorosilanes. Three of these monomers had not been previously reported. Allyldimethylvinylsilane was prepared by two different routes.

The diallylsilanes were converted to polymers by use of Ziegler catalysts. The polymers were soluble in benzene, and showed little or no unsaturation in the infrared spectra. A study was made of the effect of aging time of the catalyst upon the polymerization of diallyldimethylsilane. It was found that increased yields of polymer were obtained when the catalyst was aged for short periods before the addition of the monomer.

The dimethallylsilanes were polymerized by use of the free radical initiator di-t-butyl peroxide to give benzene soluble polymers containing little residual unsaturation. Intrinsic viscosity measurements indicate that the Ziegler catalyst initiated polymers have a higher degree of polymerization than do the free radical initiated polymers.

In view of the physical properties of these polymers it was concluded that the monomers were polymerized by the intramolecular-intermolecular chain propagation mechanism to give polymers containing cyclic recurring units.

Polymerization of allyldimethylvinylsilane gave low molecular weight polymers with both Ziegler catalyst and free radical initiators. The infrared spectra indicate that polymerization occurred through the carbon-carbon double bond of the allyl group only leaving the unreacted vinyl groups on the polymer chain.

Microfilm $2.75; Xerox $3.00. 54 pages.

THE SYNTHESIS OF POLYMETHYLENE-BRIDGED DIPHOSPHINE DIOXIDES

(Order No. Mic 61-2424)

Robert Frederick Struck, Ph.D.
Auburn University, 1961

Supervisor: Gennady M. Kosolapoff

Seventeen diphosphine dioxides with the general formula $R_2P(O)(CH_2)_nP(O)R_2$, where n = 1-6 and R = methyl, ethyl, n-butyl, or phenyl, were synthesized by various routes.

Ten of the diphosphine dioxides were conveniently prepared by reaction of the appropriate di-substituted-phosphinyl-magnesium halide with ethylene or trimethylene bis-p-toluenesulfonate. Ethylene- and trimethylene-bis (di-n-butylphosphine oxides) were also synthesized in low yield by the interaction of n-butylmagnesium bromide with ethylene- or trimethylene-diphosphonic tetrachloride. Ethylenebis(dimethylphosphine oxide) was synthesized by the latter route.

One methylene derivative, methylenebis(di-n-butylphosphine oxide), was successfully prepared. Of the numerous routes or modifications investigated, the only route which yielded the compound in isolateable quantity was the reaction between di-n-butylphosphinyl-magnesium bromide and di-n-butyl-chloromethylphosphine oxide.

An indication of the association properties of the series of diphosphine dioxides was obtained by ebullioscopic molecular weight experiments.

A discussion of the more significant conformational behavior of the diphosphine dioxides is given.

The results of an infrared absorption study of the six butyl substituted diphosphine dioxides are briefly outlined.

A series of bismuth complexes was prepared from methylene-, ethylene-, and trimethylene-bis(di-n-butylphosphine oxides).

Three liquid phosphine oxides were synthesized for the purpose of obtaining an atomic refractivity value of phosphorus in phosphine oxides.

Microfilm $2.75; Xerox $7.40. 157 pages.

AUTOXIDATION INHIBITION IN CUMENE

(Order No. Mic 61-2248)

Paul Louis Weinle, Ph.D.
The University of Florida, 1961

A detailed study of autoxidation inhibition in cumene containing either hydroquinone or 2, 6-di-tert-butyl-4-methylphenol, DBC, has been conducted. The study consisted of an examination of the inhibition process with 1) the non-branching initiator azo-bis-isobutyronitrile, 2) mixtures of tetralin and cumene with the azo-bis-isobutyronitrile, initiator, 3) the branching initiator system, cobaltous naphthenate and cumene hydroperoxide. This was accomplished by measuring the effect on the induction period of varying the concentration of inhibitor and initiator, the temperature, etc.

Results of this study have led to the following new developments:

1. Verification of the mechanism of the inhibition process for DBC. Strong evidence is presented to show that the mechanism involves reaction of dibutylcresol with two radicals. On radical abstracts a phenolic hydrogen atom; the second radical adds to the aromatic ring.

2. Evolution of a dual inhibition mechanism for hydroquinone. Strong evidence is presented to suggest that hydroquinone, or its products, inhibits both by scavanging radicals and by reducing the effectiveness of the cobaltous naphthenate catalyst. This is apparently accomplished by the formation of a complex involving the cobalt and quinone or hydroquinone. In the radical scavenging process, two radicals apparently abstract phenolic hydrogen atoms from the hydroquinone.

3. Elucidation of the kinetics of the cobaltous naphthenate catalyzed decomposition of cumene hydroperoxide. These are shown to obey the following rate law.

$$\text{Rate} = 2.2 \times 10^{14} \exp(-13{,}000 \text{ cal}/RT)[Co^{++}]^2[RO_2H]$$

4. Observation on a pronounced lengthening of induction periods in systems containing small amounts of tetralin in cumene with a non-branching initiator. This is interpreted in terms of an inhibitor-catalyzed cross-termination step involving tetralylperoxy and cumylperoxy radicals.

5. Estimation of rate constants for the direct oxidation of each inhibitor.

6. Estimation of the rate constant for the initial step in the thermal decomposition of cumene.

7. Demonstration that the azo-bis-isobutyronitrile radical efficiency factor is independent of temperature at 60° and 70° and independent of both the rate of initiator decomposition and of inhibitor concentration.

8. Postulation of possible hydroquinone induced decomposition of azo-bis-isobutyronitrile.

Microfilm $2.75; Xerox $7.40. 160 pages.

PARTICLE-PARTICLE INTERACTION IN ORGANIC MEDIA

(Order No. Mic 60-6523)

James Pinckney Wightman, Ph.D.
Lehigh University, 1960

Properties, particularly those dependent on interfacial phenomena, of solid-liquid dispersions are little understood. Even certain two component systems are much more complex than realized. Often the conclusions reached concerning such systems are incorrect or open to criticism. Consequently, a research program was designed to:

1. Determine the parameters governing the formation of gels in two component systems;
2. Study the influence of impurities, water for example, on gel structure;
3. Determine the influence of a selected group of additives on gel stability.

The basis of the experimental approach is that changes in gel structure are produced by changes in the interfacial region. Both polar and nonpolar solids were employed in low and high boiling hydrocarbons. Water was shown to be the principal impurity. The selected additives were five normal heptyl compounds, the acid, aldehyde, chloride, amine and alcohol. Gels were prepared by milling the solids at high concentrations in paraffin oil. Yield values of the gels were followed as a function of the concentrations of water or additive.

The extent and energetics of adsorption and sedimentation volumes were determined for silica – n-heptyl additive – organic liquid systems. Low concentrations of solids were used here. Water present in organic liquids was determined by Karl Fischer titration.

Water profoundly influenced the structure of gels containing polar solids. This work showed the effectiveness of less than monolayer amounts of water in promoting gel structure. Water bridges between particles produce structure at solid concentrations where a strong gel cannot otherwise form due to a small number of inter-particle contacts.

Certain heptyl additives were shown to influence gel structure of silica – paraffin oil (and other similar) systems. The alcohol and amine caused structural breakdown (fluidization) at low concentrations. The acid and aldehyde decreased the consistency only slightly even at high concentrations. The chloride had a negligible effect.

It was believed that these results could be explained on the basis of one of two existing theories of sol stabilization, i.e., steric hindrance or entropic repulsion. For this reason, the extent and energetics of adsorption of n-heptyl compounds onto silica from paraffin oil solutions were studied. These systems were water free. Much of the data could be used to support a mechanism of adsorption of the additive molecules and deflocculation by steric protection of silica particles. On the other hand, inconsistencies were observed. For example the acid adsorbed to monolayer capacity in the same concentration range as the alcohol and the heats of adsorption of these two compounds onto silica from solution were the same. Nevertheless, the alcohol caused fluidization of gels whereas the acid had only a minor influence on consistency. Obviously,

adsorption alone is not the prime requisite for structural breakdown in the silica – paraffin oil gels studied.

It was concluded that the concept of sol stabilization by entropic repulsion is not only inapplicable to the systems studied here but is not appropriate in many colloidal dispersions.

Because of the inability of current theories to explain the results, a new mechanism was proposed. Formation of association complexes, soluble in the liquid medium, between water and the functional group of the additive is proposed. Water dissolved in the dispersion medium is in equilibrium with the adsorbed water responsible for gel structure. Association of the water in the bulk solution shifts the equilibrium thereby promoting desorption of water molecules from the surface; sites are then available for adsorption of the additives. The amino and hydroxy groups which interact most strongly with water thus function as deflocculating agents.

Microfilm $2.75; Xerox $6.20. 128 pages.

REACTIONS OF FERRIC CHLORIDE WITH AROMATIC COMPOUNDS

(Order No. Mic 60-5529)

Chisung Wu, Ph.D.
Case Institute of Technology, 1960

This investigation was undertaken in order to obtain a better understanding of the reaction of anhydrous ferric chloride with aromatic compounds.

Black, insoluble organic material was obtained, together with some chlorobenzene, from the benzene-ferric chloride reaction. Small quantities of Brönsted acids markedly promoted the formation of black solid. An ionic nuclear polymerization mechanism involving co-catalysis is proposed.

The study of the interaction of ferric chloride with monoalkylbenzenes has shown that a number of competing reactions may occur: nuclear chlorination, side-chain attack leading to diarylmethanes, disproportionation and polymerization. The yields of diarylmethanes increased in the order, $C_6H_5CH_3 < \underline{p}\text{-}ClC_6H_4CH_3 < C_6H_5C_2H_5 < C_6H_5CH(CH_3)_2$, and the disproportionation products in the order, $C_6H_5CH_3 < C_6H_5C_2H_5 < C_6H_5CH(CH_3)_2 < C_6H_5C(CH_3)_3$. The chemistry of the various processes is discussed.

In the hindered aromatic series, only chlorination occurred with 1,2,4,5-tetrachlorobenzene, and side-chain attack with pentamethylbenzene. From mesitylene, however, chloromesitylene and bimesityl were the major products isolated. The complex, $ArFeCl_2 \dashrightarrow FeCl_3$, is proposed as a common element in pathways leading to chlorination and biaryl formation.

With xylenes, nuclear chlorination, side-chain attack, transaralkylation, biaryl formation and polymerization were observed. Correlations are drawn between the nature of the products and structure of the aromatic reactant.

A large number of metal chlorides were investigated for their influence as solvents or catalysts upon the aromatic-ferric chloride reaction. Yield and isomer distribution of products, and rate of the various reactions which occur were affected by certain of the metal chlorides. The significance of the results is discussed.

Microfilm $2.75; Xerox $5.60. 114 pages.

THE SYNTHESES OF ISOMERIC ALKYLPERYLENES AND THE PERYLENE MONOCARBOXYLIC ACIDS

(Order No. Mic 61-2411)

Herman Ernst Zieger, Ph.D.
The Pennsylvania State University, 1961

The syntheses of perylene-2-carboxylic acid and perylene-3-carboxylic acid have been accomplished. Some corresponding alkylperylenes (2- and 3-ethylperylenes and 2- and 3-hexylperylenes) have been prepared.

Perhydroperylenes have been obtained for the first time by the catalytic hydrogenation of perylene over W-2 Raney nickel catalyst. 1,2,3,3a,4,5,6,7,8,9,9a,10,11,12-Tetradecahydroperylenes (cis and trans) were prepared by the catalytic hydrogenation of perylene over nickel on kieselguhr catalyst. 1,2,3,10,11,12-Hexahydroperylene was prepared by the catalytic hydrogenation of perylene over copper chromite catalyst. The structures of these hydrocarbons were determined by comparison of their infrared, ultraviolet and nuclear magnetic resonance spectra with model hydrocarbons, e.g. dodecahydrotriphenylene and 4,5-dimethylphenanthrene.

Electrophilic aromatic substitution on the perylene nucleus by hexanoyl chloride (aluminum chloride) has been demonstrated to occur at position three by the alternate synthesis of 3-hexanoylperylene from perylene-3-carbonyl chloride and dipentyl cadmium.

The general procedure for the preparation of the perylene monocarboxylic acids and the alkylperylenes involved the synthesis of ketones by Friedel-Crafts acylation and hexanoylation of perylene and 1,2,3,10,11,12-hexahydroperylene. The acids were obtained by oxidation of methyl ketones with sodium hypoiodite; the alkylperylenes were secured by reduction with hydrazine hydrate (Wolff-Kishner method) or by reductive dehydrogenation with palladium suspended on carbon.

Microfilm $2.75; Xerox $5.20. 104 pages

CHEMISTRY, PHARMACEUTICAL

STRUCTURAL STUDIES OF LOGANIN

(Order No. Mic 61-2507)

Kirti Shantilal Sheth, Ph.D.
Purdue University, 1961

Major Professor: Egil Ramstad

A search of the literature for the structural study of loganin revealed scanty and conflicting data. In 1956,

a keto-ester structure for loganin isolated from Strychnos lucida was proposed while in 1957, loganin extracted from Strychnos Nux-vomica was assigned an α,β-unsaturated γ-lactone structure. The present investigation is concerned with the examination of the structure of loganin from S. Nux-vomica.

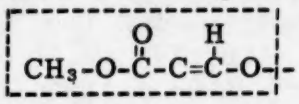
From the U.V. and I.R. spectra of loganin, the assumptions of a lactone and keto-ester structure are proved incorrect. Instead of these structures, an α,β-unsaturated ester structure is proposed for loganin.

Nor-loganin, obtained upon alkaline hydrolysis of loganin, is an acid which can be titrated in the cold. Diazomethane converts penta-acetylnorloganin to penta-acetylloganin.

Ozonolysis of loganin yields formaldehyde, indicating the presence of an unsaturated methylene group in the molecule. This concept is confirmed by the formation of formaldehyde by treatment of loganetin with osmium tetroxide and sodium periodate.

Loganin is hydrogenated with ease in glacial acetic acid and by use of platinum oxide as a catalyst. From the loss of the absorption maximum in U.V. light and from the loss of the absorption band at 1660 cm^{-1} in the IR spectrum, it is concluded that the double bond conjugated with the ester structure is hydrogenated. The genin obtained by hydrolysis of dihydrologanin yields formaldehyde by treatment with osmium tetroxide and sodium periodate. The unsaturated methylene group, therefore, must be sterically protected against catalytic hydrogenation.

Experimental evidence shows that loganin has 2 rings and 3 double bonds in its molecule. Of the 10 oxygen atoms present, 5 are located in the glucose residue, 2 form a part of the ester structure and one constitutes the free hydroxy group of the aglycone and one forms the glycosidic link. From the ultra-violet spectral studies, the 10th oxygen atom forms a part of the chromophore,



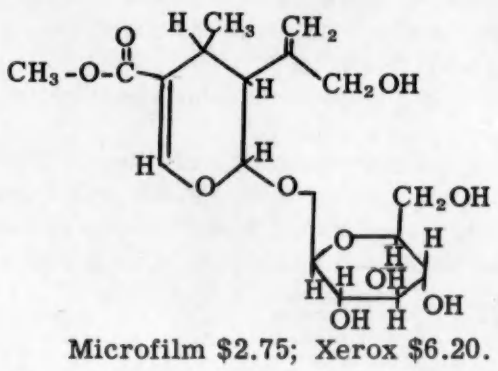
. The latter is responsible for the ultra-violet absorption maximum of loganin at 236 mμ. The various findings assign this chromophore to form a part of the dihydropyran ring structure.

Acetic, oxalic and methylsuccinic acids are identified in the acid mixture obtained upon oxidation of loganetin with alkaline permanganate. An acid of undetermined structure, melting at 146-8°, is also isolated from this acid mixture.

Loganin, as well as nor-loganin, yields a mixture of genins upon acidic hydrolysis. These genins give precipitates with 2,4-dinitrophenylhydrazine t.s.

The name protologanetin is proposed for the genin as it exists in loganin.

The findings indicate the following formula for loganin: [protologanetin-β-D-glucoside-(6)]



Microfilm $2.75; Xerox $6.20. 127 pages.

THE SYNTHESIS OF SOME PHENYL(2-HYDROXY-3-PYRAZYL)CARBINOLS AS POSSIBLE ANTIMETABOLITES OF SEROTONIN

(Order No. Mic 61-1891)

Vincent Steven Venturella, Ph.D.
University of Pittsburgh, 1961

The purpose of this investigation was to prepare certain compounds, heretofore unprepared, which might have properties that would permit them to compete biologically with the naturally occurring tryptamine, serotonin.

In this investigation, compounds were prepared which differed from serotonin in that they did not contain the indole nucleus but were similar in the comparative distances between nitrogen functions and hydroxy function. Assuming that the significance of the antagonism or antimetabolic activity of certain indoles and serotonin derivatives was due to the two nitrogen functions, compounds were chosen on the basis of biological isosterism enhanced by the replacement of the aliphatic nitrogen function with an aromatic nitrogen. Using this assumption, a choice among the three conjugated diazines was made. Pyrazine was chosen as the diazine. The presence of a ring hydroxyl group and also a hydroxyl group on the side chain in a position adjacent to the ring hydroxyl was chosen because of the apparent importance of added hydroxyl groups in antimetabolites according to Woolley and associates.

The parent compound of this series was phenyl(2-hydroxy-3-pyrazyl)carbinol. The substituted compounds that were synthesized were those with H, CH_3; CH_3, CH_3; and C_6H_5, C_6H_5 in positions 5- and 6- respectively.

The method that was used for the synthesis of these compounds was originally developed by R. G. Jones. In this study, the amide of β-phenylserine was needed as the intermediate for the cyclization reaction with the appropriate α-dicarbonyl compound. Because of the steric requirements for the cyclization, the threo isomer of the amide was used.

It was noted during the initial stages of the synthesis that the erythro isomer of the amide was formed preferentially during the regular ammonolysis step and that the isomerization to the erythro form could be minimized by the utilization of the Bergmann carbobenzoxy method to protect the intermediate during the ammonolysis.

The inability to prepare other 2-derivatives has been explained on the basis that the hydroxy group in the 2-position of the prepared compounds is thought to be shielded by the presence of the phenylcarbinol moiety in the 3 position in such a way as to prevent the participation of the 2-hydroxy group in normal hydroxylic reactions. However, it was found that by utilizing the phenolic character of the ring hydroxyl group, O-methyl derivatives could be prepared by reacting the compound with dimethylsulfate in basic solution.

The total yield of the final condensation product, based on the starting material was low, but the sequence of reactions studied provided a route to the preparation of compounds which could not be prepared by any direct route presently available.

Microfilm $2.75; Xerox $4.60. 86 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

CHEMISTRY, PHYSICAL

THE ELECTRONIC SPECTRA AND STRUCTURES OF THE CARBOXYL GROUP AND RELATED SYSTEMS

(Order No. Mic 61-2092)

Edwin Ellsworth Barnes, Ph.D.
University of Washington, 1961

Chairman: W. T. Simpson

The electronic absorption spectra of the vapors of monomeric formic, acetic, propionic and isobutyric acids; of dimeric formic and acetic acids; of formate and acetate esters; and of propio- and γ-butyro- lactones have been recorded in the 45-80 kk frequency region. These spectra demonstrate the presence of at least five characteristic absorption bands of the carboxyl group, and disclose the energy shifts which they undergo in the various intra- and inter-molecular environments. The observed behavior of the absorption bands is of considerable value to the problem of assigning the electronic transitions involved.

Some vapor, solution, melt and crystal absorption spectra of various aldehydes and ketones have been recorded, which, in conjunction with the information already present in the literature, offer evidence which leads to the assignment or reassignment of the higher frequency electronic transitions which occur in the carbonyl group.

The vapor spectra of dimethyl carbonate, acetic anhydride, and formyl and acetyl fluorides have also been recorded down to 80 kk. Assignments for the electronic transitions responsible for the observed absorptions are proposed.

Hückel theory models of the carbonyl, carboxylate, carbonate and acid anhydride groups are examined and found to be of some value in correlating the pi-pi* transitions. The empirical data used in applying the Hückel theory are the frequencies of the n-pi* transitions and the frequency of the pi-pi* transition of the carboxylate ion. This latter frequency is extrapolated from the aqueous solution spectra of lithium formate and lithium acetate using the spectrum of trimethylformamidinium ion as a model. Since the frequency that is obtained for the transition is very similar to that observed for the pi-pi* transition of the amide group, it is felt that the extrapolation is reasonably accurate. The pi systems of the amide group and the carboxylate and formamidinium ions are three-centered; each system contains four electrons.

Microfilm $3.35; Xerox $11.70. 258 pages.

THE THERMAL DECOMPOSITION AND HYDROGENATION OF DIBORON TETRACHLORIDE AND DIBORON TETRAFLUORIDE

(Order No. Mic 61-2351)

John Baldwin Barr, Ph.D.
The Pennsylvania State University, 1961

Kinetic studies have been carried out on the thermal decomposition and hydrogenation of diboron tetrachloride. Diboron tetrafluoride was studied in a similar, but more abbreviated, fashion.

The decomposition of gaseous diboron tetrachloride was found to yield trichloroborane and nonvolatile solid subchlorides. Investigations at temperatures ranging from 138°C. to 155°C. showed the decomposition to be a second order heterogeneous reaction strongly retarded by its reaction products.

Heterogeneity was demonstrated in experiments which involved measuring the effect of large surface-to-volume ratios on the decomposition rate. The dependence of the rate on the surface area of the catalyst was clearly shown by decompositions in packed vessels and flow system experiments.

The search for the retarding agent led to tests of the effect of added trichloroborane and of the nonvolatile reaction products on the decomposition rate. It was found that both high pressures of trichloroborane and the solid products from a previous decomposition retarded the reaction, but low and moderate pressures of trichloroborane resulted in an acceleration in rate. Additional study showed the rate to be unaffected by added nitrogen or exposure of the heated samples to light.

The mechanism of the reaction between diboron tetrachloride and hydrogen was investigated using infrared techniques and pressure change measurements. These experiments showed that diboron tetrachloride completely disappeared within three minutes after mixing with hydrogen. In addition, the rate of reaction was found to be unaffected by exposure to light. The infrared spectrum of the reaction products showed the presence of trichloroborane, diborane, dichloroborane and monochlorodiborane.

Dichloroborane appeared immediately in the diboron tetrachloride-hydrogen reaction mixture and was observed to disproportionate reversibly into diborane and trichloroborane. This equilibrium was also approached from the diborane-trichloroborane side. The latter reaction also resulted in the slow formation of monochlorodiborane.

In the course of these investigations, it became apparent that product diborane was also reacting with the reactant, diboron tetrachloride. Separate experiments showed the latter reaction to be rapid and to produce the same major products as the diboron tetrachloride-hydrogen reaction.

Decaborane was also found to react readily with diboron tetrachloride again to yield the products observed for the diboron tetrachloride-hydrogen reaction.

A brief investigation of the room temperature reaction of diboron tetrafluoride with hydrogen showed these compounds to interact at a much slower rate than the corresponding diboron tetrachloride-hydrogen reaction, diboron tetrafluoride was found to persist in the reaction mixture 140.5 hours after mixing with hydrogen. The infrared spectrum of the reaction products showed the presence of trifluoroborane, diborane, and several unidentified peaks.

In a separate study diboron tetrafluoride was found to react slowly with diborane to yield products which were essentially the same as those from the diboron tetrafluoride-hydrogen reaction.

A study of the decomposition of diboron tetrafluoride showed this compound to be thermally much more stable than diboron tetrachloride. The products of the decomposition consisted of trifluoroborane and of solids which were involatile at temperature up to 375°C.

A similar study on the thermal stability of tetraboron tetrachloride showed no decomposition of this compound at 150°C., but at 320°C. all of the tetrachloride disappeared yielding trichloroborane and unidentified solid boron subchlorides.

Microfilm $2.75; Xerox $9.45. 209 pages.

A STUDY OF THE OXIDATION OF THIOCYANATE BY ACIDIC NITRITE AND NITRATE SOLUTIONS

(Order No. Mic 61-2354)

Waddell Alexander Biggart II, Ph.D.
The Pennsylvania State University, 1961

A kinetic study was made of the reaction of thiocyanate ion with nitrate or nitrite ion in acid solution. The oxidation of thiocyanate ion by nitrate and nitrite was found to be acid dependent and the oxidation with nitrate ion was found to be autocatalytic with the production of nitrous acid. The products of the reaction when the oxidant was present in excess were cyanide ion, sulfate ion and nitric oxide. Since other products in variable amounts were obtained when thiocyanate ion was present in excess, all kinetic measurements were made on mixtures in which the oxidant, either nitrite or nitrate, was present in large excess. Reaction rates were determined by measurement of the amount of unreacted thiocyanate. Thus the order of the reaction with respect to thiocyanate ion could be measured directly. It was necessary to investigate the order of reaction with respect to hydrogen ion and nitrite ion indirectly, also by following the disappearance of thiocyanate. The analytical method involved a complexation of thiocyanate with Fe(III) and an absorbimetric determination at 465 mμ of the concentration of the complex.

The empirically determined rate law for the nitrite oxidation of thiocyanate contained a first order dependence in hydrogen ion, in thiocyanate ion and in nitrous acid as according to the following equation:

$$v = k\,[SCN^-]\,[HNO_2]\,[H^+]$$

This rate law was determined in the concentration range of 0.87 to 3.79 M perchloric acid, 0.0500 to 0.300 M sodium nitrite and at a maximum initial concentration of 0.02 M in thiocyanate ion.

A reddish coloration was formed during the oxidation of the thiocyanate by both nitrate and nitrite ion. This coloration was probably due to nitrosyl thiocyanate and was formed immediately upon the mixing of the reactants in the nitrite oxidation and after an hour or two in the nitrate oxidation – the time of formation being dependent on the reacting conditions. The data obtained in the investigation indicate that the oxidative process is the same in both of the systems. The reaction was an oxidative attack by nitrosyl ion (or nitrous acidium ion) on the nitrosyl thiocyanate formed in the reaction according to the following scheme

$$HNO_2 + H^+ \rightleftharpoons NO^+ + H_2O \qquad \text{(fast)}$$

$$NO^+ + HSCN \rightleftharpoons NOSCN \qquad \text{(fast)}$$

$$NO^+ + NOSCN \longrightarrow \text{Products} \qquad \text{(rate determining)}$$

The initiation period in the nitrate ion case was explained by the immediate reaction of any nitrosyl ion produced in the nitrate ion system to form nitrosyl thiocyanate. Because of the formation of this intermediate, there is very little free nitrosyl ion to give rise to an oxidative attack on the nitrosyl thiocyanate. Thus, it is necessary to form sufficient nitrosyl ion during the initiation period to react with all the thiocyanate before any large amount of the nitrosyl thiocyanate can be oxidized. The reaction mechanism in the nitrate oxidation once initiated was considered to be identical to the mechanism in the nitrite ion case.

The temperature coefficient of the nitrite oxidation of thiocyanate was determined in the range 0° to 46°. From these results an energy of activation of 15.9 kcal/mol was calculated and the following equation was written to express the dependence of the specific rate constant on temperature:

$$k = 1.12 \times 10^{11} e^{-15{,}900/RT}$$

Microfilm $2.75; Xerox $4.60. 87 pages.

AN ELECTRICAL TRANSPORT STUDY OF POLYPHOSPHATES

(Order No. Mic 61-2174)

Sydney Bluestone, Ph.D.
Rutgers University, 1961

Major Professor: Ulrich P. Strauss

This thesis describes an experimental study in which the binding of univalent cations, namely, Na^+, Li^+, K^+ and and TMA^+, by long-chain polyphosphates in solutions of the bromides of the corresponding cations at 0°C has been determined from conductivity and electrophoresis data.

The equivalent conductance of the electroneutral polyphosphates (in the experimentally accessible regions investigated) has been found to be independent of the polyion concentration in the excess salt solutions employed as solvents, and also independent of the molecular weight of the polymer. The molecular-weight range employed in this study was exceedingly broad, varying from a D.P. of about 130 to 26,500. The Walden product for a tetramethyl-ammonium polyphosphate polymer remained constant with a change in temperature from 0°C to 25°C. These experimental results indicate an absence of a specific viscosity dependence.

The conductance and mobility data were interpreted in terms of several recent polyelectrolyte theories. If the polymer is free-drained, the results predict, in the absence of relaxation phenomena, that the electrophoretic mobility of the polyion should be proportional to the degree of ionization. By combining the equivalent conductance data with the corresponding electrophoretic mobility values, the degree of ionization, i, of each of the polyphosphates was calculated by means of the Kohlrausch equation. The resulting values of i are proportional to the values of the mobilities at a constant ionic strength of 0.2 to 0.06 for each polyphosphate. This shows that the frictional coefficient of each polymer remains constant with a change in ionic strengths from 0.2 to 0.06 and,

together with the independence of transport properties with molecular weight and other experimental evidence, lends support to the interpretation that the polyphosphates are free-drained. The over-all variation of the friction constant, with a decrease in ionic strength from 0.2 to 0.02, was found to change from 3.1 to 1.8 x 10^{-9} gm. sec.$^{-1}$. The range of the friction coefficient may be due in part to the assumption used in calculating λ_c, the average equivalent conductance of the ionized counterions of the polyelectrolyte. Since it cannot be independently determined, it is assumed to be equal to the equivalent conductance of the counterions in the solution of the simple electrolyte serving as solvent. This implies that the polyions have no effect on the conductance of the simple ions, an assumption at low ionic strengths which probably results in values somewhat too high for λ_c, thus yielding values of i, which are too low. Nevertheless, the degrees of ionization so obtained from our transport measurements are probably the best experimental values now available for the polyphosphates in extraneous salt solutions. The degrees of ionization indicate that the binding constants are increasing in order of decreasing anhydrous radii of the counterions. Only the orders of Li^+ and Na^+ are out of line, and since the binding of these two counterions is very close together, secondary effects may account for this trend.

A cylindrical model was compared to the porous sphere model. The agreement between the models gives support to the hypothesis that the polyphosphate segments (considered as spheres or parts of a stiff rod) do not interfere with each other.

Microfilm $2.75; Xerox $5.60. 113 pages.

ELECTRON SPIN RESONANCE SPECTROSCOPY IN IRRADIATED POLYPROPYLENES

(Order No. Mic 60-4741)

Tomas Buch, Ph.D.
Northwestern University, 1960

High energy radiation produces free radicals in Polypropylene as in most other materials. These radicals, produced by gamma rays from Co^{60}, have been investigated by means of Electron Spin Resonance Spectroscopy.

The spin spectrum of Atactic Polypropylene, irradiated at 77°K consists of a symmetric quartett and a broad background line, when measured at 77°K. At higher temperatures, this single line narrows considerably, according to a law of the form $\Delta H = (\Delta H)_o e^{-aT}$, and it can be bleached by illumination with light from a mercury arc.

The spectrum of Isotactic Polypropylene, when irradiated at 77°K consists of a symmetric sextett, with the same broad line superimposed ("Primary Spectrum"). When the isotactic samples are annealed by heating to -28°C for several minutes, the spectrum changes into a 9-line pattern, the background line still being present. This spectrum ("Secondary Spectrum") changes its multiplicity when measured at temperatures higher than 77°K, reaching a maximum of 17 lines at 155°K; this transformation is reversible. When the irradiation is performed at room temperature, this spectrum appears directly.

The primary spectrum of both the atactic and isotactic materials are reproduced by a theoretical model based on the idea that the primary effect of the radiation is to break all possible bonds in the molecule with equal probability in the atactic material, but that the amount of chain scission is negligible in the isotactic. A qualitative discussion of a possible reason for this difference is proposed.

The secondary spectrum, which is observed only in the isotactic polypropylene, is interpreted as being due to the radical $-CH_2-\dot{C}(CH_3)-CH_2-$. At the lowest measured temperature the methyl groups are fixed in position by a potential energy barrier, and the three methyl protons are not equivalent in their hyperfine coupling to the free electron spin. At higher temperatures, the methyl groups are gradually excited into higher torsional states, in which their coupling is equivalent. By assuming convenient values of the hyperfine coupling parameters, the observed spectra can be reproduced theoretically in a satisfactory manner; this is done by superimposing the two spectra expected from the different coupling parameters for the ground and excited states, in proportions given by a Boltzmann distribution with the temperature. The energy corresponding to the excitation of the torsional levels is herefrom calculated as E = 300 cal/mole.

A quantum mechanical analysis of the coupling parameters is based on a Valence Bond Theory approach. By taking into account the effect of configurational interaction, it is found that the hyperfine interaction parameter depends on the expectation value of the operator $|\cos\chi|$, where χ represents the position of the methyl group around its axis, calculated for the torsional eigenstate of this group. The theoretical values of the hyperfine interaction parameters calculated from this model agree with the observed values in a satisfactory manner for the ground state. The discrepancy in the values for the excited state is brought into relationship with an observed anomaly in the coupling of the methylene protons, and an explanation of this anomaly is attempted in an appendix.

The comparison between the observed transition energy between the ground and excited states and the value calculated from the solution of Schrödinger's equation for the hindered rotator leads to the value of 210 cal/mole for the potential energy barrier against internal rotation in the radical. Microfilm $2.75; Xerox $5.20. 105 pages.

THE CRYSTAL AND MOLECULAR STRUCTURE OF CHLORANIL

(Order No. Mic 61-1862)

Shirley Shan-Chi Yu Chu, Ph.D.
University of Pittsburgh, 1961

The crystal structure of chloranil has been determined by X-ray diffraction method. The chloranil crystal is monoclinic, with unit cell dimensions a=8.708, b=5.755, c=8.603 Å and β=105°51'. It belongs to the space group P_{21}/a and there are two molecules in a unit cell. These two molecules occupy the two-fold special positions which are the centers of symmetry produced by the space group.

The trial structure was determined by the Patterson synthesis and preliminary refinements were carried out by two dimensional analysis. Three dimensional Fourier, differential Fourier and least squares methods with isotropic temperature factors were used in subsequent

refinements. Finally, the anisotropic least squares refinement was carried out and percentage discrepancy was 11.1%.

The intramolecular constants in chloranil have been evaluated from the final atomic coordinates and are all in agreement with the values expected theoretically. The lengths of carbon-chlorine bond, carbon-carbon single bond, carbon-carbon double bond and carbon-oxygen bond are 1.714±0.008, 1.477±0.011, 1.342±0.011 and 1.195±0.011 Å, respectively. The C-C-C bond angle is 117°16'±41' and the angle between the adjacent carbon-chlorine bonds is 64.9±1.5°. The quinoid ring is planar within the standard deviation but the adjacent chlorine and oxygen atoms are tilted about 0.05-0.06 Å out of the mean plane in opposite directions. The X-ray data of carbon-chlorine bond directions are in good agreement with those determined from the nuclear quadrupole resonance measurements. However, there exist anomalous intermolecular distances (2.85, 3.06, 3.14 Å) between oxygen and carbon atoms, considerably smaller than the van der Waal distance. Since the established structure has been shown to be the true solution, the observed short intermolecular distances are attributed to intermolecular electronic interactions. A comparison of some physical properties of chloranil with those of analogous compounds seems to support this view.

The anisotropic thermal motion of the chloranil molecule in the crystal was also analyzed. The principal axes of thermal vibration coincide with the molecular axes within experimental error. The root mean square amplitude of translational oscillation along the molecular plane normal is 0.15 ± 0.06 Å and those along the two axes on the molecular plane are 0.19 ± 0.05 and 0.21 ± 0.05 Å. The root mean square amplitudes of angular oscillation about the three molecular axes are 4.2° ± 1.4°, 4.1° ± 1.3° and 3.6° ± 1.6°.

Microfilm $2.75; Xerox $6.00. 125 pages.

THERMODYNAMIC PROPERTIES OF HIGH TEMPERATURE AQUEOUS SOLUTIONS

(Order No. Mic 61-2466)

Cecil M. Criss, Ph.D.
Purdue University, 1961

Major Professor: James W. Cobble

A survey of the literature has been undertaken to collect thermodynamic functions for aqueous solutions of electrolytes at 60°, 100°, 150°, and 200°C. These have been used to calculate the partial molal entropies of approximately thirty electrolytes at higher temperatures.

These data have been supplemented by measurements in this laboratory. A sensitive submarine type solution calorimeter using electronic amplification and automatic recording has been constructed to measure heats of solution up to 100°C. Nearly 300 integral heats of solution of sodium chloride and barium chloride have been determined at various concentrations from near 0°C. to 95°C. From the extrapolated values of the heats at infinite dilution, values of $\overline{C}^{\circ}_{p_2}$ as a function of temperature have been calculated for these salts. The observed heat capacities show maxima between 50° and 70°C. and then decrease as the temperature is further increased. These data were used to extend the partial molal entropies of sodium chloride and barium chloride at 25°C. to 60° and 100°C.

By means of correspondence plots the ionic partial molal entropies at 60°, 100°, and 150°C. were correlated with the "absolute" ionic partial molal entropies at 25°C. When a "correct" division of the entropies of electrolytes into ionic values is made, three linear entropy correlations are obtained: one for cations, one for simple anions, and another for oxygenated anions. From these correlations, equations have been derived that now make it possible to estimate the ionic entropy of many species from 25° to 200°C. within an accuracy of one or two entropy units.

Equations are also presented which give an estimated average ionic partial molal heat capacity at 60°, 100°, 150°, and 200°C. A table of "best" values of average heat capacities for about forty-five ions up to 200°C. is given.

The estimated ionic heat capacities can be used to extend the standard free energies from 25°C. to higher temperatures. Electrode potentials and hydrolysis constants of representative reactions have been estimated up to 200°C. It is also shown how these data can be used to estimate solubilities of electrolytes and ionization constants of weak acids. An attempt has been made to explain the theoretical significance of the behavior of the ionic properties.

Finally, details are given for construction of an improved submarine type solution calorimeter which should have a temperature sensitivity approaching one microdegree. Microfilm $3.00; Xerox $10.60. 232 pages.

STUDIES IN EQUILIBRIUM POLYMERIZATION

(Order No. Mic 61-1986)

Adi Eisenberg, Ph.D.
Princeton University, 1960

Reactions in which small molecules polymerize to species many thousandfold greater have long been of both theoretical and practical interest, since they give rise to the great variety of plastics, rubbers, and related materials so basic to modern civilization. The kinetics of the reactions have been investigated widely in the past, and in many cases the mechanisms elucidated. It was realized that in certain instances polymerization reactions could lead to equilibrium, and while studies were made with this in mind, only the equilibrium in the propagation reaction was studied, while that in the initiation reaction was neglected. It is the purpose of this work to apply a general theory of equilibrium polymerization, which takes into account both the propagation and initiation equilibria, to several compounds characteristic of the very wide range of polymerizable materials, both organic and inorganic, i.e. the nylons, vinyl monomers, and sulfur and selenium.

This theory correlates the original and equilibrium monomer concentrations (written as $\underline{Mo}$ and $\underline{M}$), original and equilibrium initiator concentrations, where applicable (written as $\underline{XYo}$ and $\underline{XY}$), the degree of polymerization (P), and the equilibrium constants for the initiation and propagation reactions (K and K_3). Polymerizations involving a

specific chemical initiator are designated as Case I, while those polymerizing spontaneously are classified under Cases II and III (II may be regarded as a special instance of Case III and is given separately only on the basis of convenience). Furthermore, those instances may be distinguished in which all the equilibria are subject to one equilibrium constant, and those in which the constant for the initiation reaction differs from that for the propagation reactions. The following cases were studied:

Case I-a: ϵ-caprolactam initiated by water. The equilibria involved are

$$XY + M \underset{}{\overset{K}{\rightleftharpoons}} XMY \quad \text{and}$$

$$XMnY + M \overset{K_3}{\rightleftharpoons} XMn\ Y.$$

The resulting equations are:

$$P = 1/(1 - K_3\underline{M})$$

$$\underline{Mo} = \underline{M}[1 + K(\underline{XY})P^2]$$

$$(\underline{XYo}) = (\underline{XY})(1 + K\underline{M}P), \text{ and}$$

$$P = (\underline{Mo} - \underline{M})/(\underline{Xo} - \underline{X})$$

The concentrations are expressed in mols/kg. From an analysis of three sets of data given in the literature the following results are obtained: $\Delta H^\circ = 2240$ cal/mol and $\Delta S^\circ = -6.8$ e.u. for initiation, and $\Delta H_3^\circ = -4030$ cal/mol and $\Delta S_3^\circ = -7.0$ e.u. for the propagation reaction. Also, one equation is obtained which yields P as a function of the initial conditions for bulk polymerization in the liquid phase, i.e. $\log P = (2.46\text{-}0.00241g)\text{-}(0.436+0.000465t) \log \underline{Xo}$ where t is the temperature in °C.

Case I-b. caprolactam initiated by an alkyl amine or an organic acid. This case differs from the preceding only in that $K = K_3$. It was not investigated experimentally, but the following conclusions can be drawn on theoretical grounds:

1) The equilibrium monomer concentration is a function of the temperature only, and is independent of the nature of the initiator.

2) The degree of polymerization may be expressed as

$$P = (\underline{Mo} - \underline{M})/(\underline{XYo})$$

Case I-a'. α methylstyrene initiated by sodium diphenylacetylene. This case was investigated experimentally at 0°C. It differs from Case I-a only in that two molecules of the initiator are needed per polymer molecule; in other words, the diphenylacetylene radical ion attaches itself to the monomer yielding a true free radical anion, which dimerizes and propagates. The degree of polymerization is expressed as

$$P = 2(\underline{Mo} - \underline{M})/\underline{Zo} + (\underline{Mo} - \underline{M})/(K\,\underline{M}^2\underline{Zo}^2)$$

where $\underline{Zo}$ is the original initiator concentration and K was found to be 0.091 kg^3/mol^3 ($\underline{M} = 0.89$ mols/kg).

Case I-c. This very specialized case deals with the initiation of vinyl monomers by organometallics in which both coupling to monomer and electron transfer occurs. No actual example is worked out, but only theoretical calculations are presented.

Case I-d. α methylstyrene initiated by sodium naphthalene. This system was investigated experimentally at 0°C. It differs from Case I-a' in that the initiator does not attach itself to the monomer, but only electron transfer occurs, yielding a free radical anion which couples to a dianion and polymerizes. The equations developed for Case I-a' apply here in a somewhat modified form.

Case II. The spontaneous polymerization of sulfur and selenium. The following equilibria apply:

$S_8 \overset{K}{\rightleftharpoons} S_8^*$ (The star denoting a diradical), and

$$S_x^* + S_8 \overset{K_3}{\rightleftharpoons} S_{x+8}^*$$

Equations similar to those developed for Case I-a are presented, i.e.

$$P = 1/(1 - K_3M), \text{ and}$$

$$\underline{Mo} = \underline{M}\ (1 + KP^2), \text{ from which we obtain}$$

$$K_3\underline{Mo} = (P - 1)/P + K\,P(P\text{-}1) \approx 1 + K\,P^2$$

In the case of sulfur, approximate values of P and M at different temperatures were taken from the literature. The thermodynamic constants were calculated from these values ($\Delta H^\circ = 32{,}800$, cal/mol, $\Delta S^\circ = 23.0$ e.u., $\Delta H_3^\circ = 3{,}170$ cal/mol, $\Delta S_3^\circ = 4.63$ e.u.), and the whole P vs T curve predicted from the above equations. The transition temperature is a direct consequence of the thermodynamic constants involved.

In the case of selenium, ΔH_3° (=2270 cal/mol) and ΔS_3° (=5.47 e.u.) were calculated from precise values of the equilibrium monomer concentrations given in the literature. ΔS° was taken as 23 e.u. (same as for sulfur), and ΔH° is estimated as 25,000 cal/mol. The calculated transition temperature (83°C) occurs below the melting point of selenium, and is thus not observed experimentally. The chain length at the melting point was estimated as 1300 Se_8 units.

Case III. The two constant approximation, might conceivably apply to the thermal polymerization of vinyl monomers, while the one constant case might be applicable to the polymerization of sulfur and ϵ caprolactam to larger rings by bond interchange.

Microfilm $2.75; Xerox $6.00. 122 pages.

EXCITON THEORY: APPLICATION TO H-BONDED COMPLEXES.

(Order No. Mic 61-1278)

Mohamed Ashraf El-Bayoumi, Ph.D.
The Florida State University, 1961

Exciton theory was applied to hydrogen-bonded systems to explain the modification of electronic absorption spectra due to dimerization and the effect of hydrogen-bonding complex formation on the emission spectra. It is thought that a clear understanding of the spectroscopic properties of simple hydrogen-bonded complexes should lead to a better understanding of the electronic excitation properties of biological macromolecules as proteins and nucleic acids

in which different parts of the molecule are held together by hydrogen bonds.

In hydrogen-bonded complexes it was necessary to take into account the perturbation effect of the hydrogen bond on the spectra, in addition to the exciton interaction effect which results from exchange of excitation energy in the dimer. The hydrogen-bonding perturbation effect leads to a shift to a higher or lower frequency. The magnitude of such a shift (which amounts to few hundred wavenumbers cm^{-1}) depends mainly on the relative strengths of the hydrogen bond in the ground state in the excited state in question. The magnitude of the shift caused by exciton interaction is a function of the oscillator strength of the transition of the free molecule under study and to a great extent depends on the distance between the interacting molecules. The shift and the selection rules for the dimer depend a great deal on the mutual geometrical orientations of the molecules in the dimer.

The experimental approach consisted of a room temperature study of the absorption as a function of concentration in a medium which favors hydrogen-bonding dimerization. The absorption spectra were determined also in solvents which allow only the formation of hydrogen bonds between the solute and the solvent molecules. The systems studied are 7-azaindole, N,N'-diphenylformamidine, indigo, α-naphthoic acid and β-naphthoic acid. A variety of selection rules are offered by such systems due to the different geometrical orientations of the molecules in the dimers of these five systems.

Qualitative agreement between predicted and observed selection rules as well as quantitative agreement between calculated and observed exciton splitting indicate the validity of the application of the exciton approximation to this problem. The results were not explainable in terms of overlap of orbitals in the electronegative atoms joined by the hydrogen bond.

To demonstrate that exchange of excitation energy occurs in hydrogen-bonded complexes the effect of hydrogen-bonding association in the strong emission spectrum of carbazole was studied at 77° K. in rigid glass. It was found that in a hydrocarbon glass the emission is greatly quenched in the presence of equimolar quantities of acridine (10^{-4} moles/liter). In alcoholic media, the presence of acridine has little effect on the emission of carbazole. This was interpreted as resulting from the formation of hydrogen-bonded complexes between acridine and carbazole and consequent interactions of the π-systems of the two molecules. These results were supported by experiments using N-ethyl carbazole in the place of carbazole. Other experiments on the same system seem to indicate that hydrogen-bonded complexes may act as energy trapping agents.

Microfilm $2.75; Xerox $8.00. 173 pages.

THE PREPARATION AND STRUCTURE OF GROUP V TRICYANIDES

(Order No. Mic 61-2140)

Kenneth Emerson, Ph.D.
University of Minnesota, 1961

The investigation of a number of possible preparative methods for group V tricyanides is reported. These methods are successful only for the preparation of phosphorus and arsenic tricyanides; no way has been found to prepare antimony or bismuth tricyanide.

The crystal and molecular structure of arsenic tricyanide has been determined by x-ray diffraction methods. The unit cell is monoclinic, belongs to space group C2, and has dimensions a = 9.19 A, b = 6.90 A, c = 8.92 A.

The space group and unit cell for the crystal structure of phosphorus tricyanide have been determined, but its structure has not been solved. The unit cell is tetragonal, belongs to space group 14_1md, and has dimensions a = b = 14.01 A, c = 10.8 A. Disorder is believed to be present in this crystal structure.

Microfilm $2.75; Xerox $3.60. 61 pages.

DONNAN MEMBRANE EQUILIBRIUM STUDIES OF A POLYELECTROLYTE AND A POLYSOAP DERIVED FROM POLY-4-VINYLPYRIDINE

(Order No. Mic 61-2184)

Donald Boyd Fraser, Ph.D.
Rutgers University, 1961

Major Professor: U. P. Strauss

A polyelectrolyte and a polysoap were prepared from poly-4-vinylpyridine: the former by quaternizing with ethyl bromide and the latter by quaternizing with dodecyl bromide and ethyl bromide. Twenty-nine per cent of the available pyridine groups of the poly-4-vinylpyridine were reacted with dodecyl bromide, while ethyl bromide occupied the remaining available sites.

These compounds were used in Donnan membrane equilibrium experiments with both hydrogen bromide and potassium bromide as the simple electrolytes. These dialysis studies produced unrealistic figures for the degree of ionization of the polyelectrolyte and the polysoap if activity coefficients were ignored.

Donnan data can be interpreted in terms of molecular models for the poly-ions. For the polyelectrolyte, a cylinder surrounded by the ionic atmosphere associated with the poly-ion gave good results. For the polysoap, the smaller Donnan effect could only be interpreted in terms of overlapping of the ionic atmospheres of different portions of the polymer chain. Considering the polysoap as a sphere surrounded by an ionic atmosphere led to unreasonably small values for the radius of such a sphere.

A difference in the Donnan membrane effects was observed in the two solvent systems studied. This difference is attributed to a greater compactness of the polyelectrolyte coil in KBr than in HBr; this greater compactness was further substantiated by viscosity measurements in the same solvents.

Some exploratory experiments were performed using e.m.f. techniques. A glass electrode, silver-silver bromide electrode system was found to be satisfactory for examining hydrogen bromide solutions alone but was unsatisfactory for studying the poly-ion. Apparently there is sufficient current flowing while measurements are being taken to cause the evolution of Br_2, which reacts with the poly-ion to form a new material. This material affected

the e.m.f. results so that they could not be reconciled with the Donnan results.

A thermodynamic correction factor relating the interactions of the poly-ion with the simple electrolyte was determined. Values of this factor which are necessary for the proper interpretation of light-scattering results are given. Microfilm $2.75; Xerox $5.00. 98 pages.

NON-ISOTHERMAL REACTION KINETICS. THE DEHYDRATION OF CALCIUM OXALATE MONOHYDRATE AND THERMAL DECOMPOSITION OF CALCIUM CARBONATE IN THE SOLID STATE.

(Order No. Mic 61-2185)

Eli Saul Freeman, Ph.D.
Rutgers University, 1961

Major Professor: Benjamin Carroll

A new method for evaluating the kinetics of chemical reactions is explored. The procedure is based upon non-isothermal experiments which involve heating a sample to elevated temperatures at a predetermined rate, while simultaneously following the course of reaction. Equations are derived for non-reversing reactions which may be used to evaluate the kinetics of reaction from a single non-isothermal experimental curve or from several curves obtained at different rates of heating. The effect of heating rate on the rate of reaction, as a function of time, temperature and quantity of reactant, is also investigated. The derived expressions are applied to the experimental methods of thermogravimetric analysis and differential thermal analysis.

The derived relationships are used to study the kinetics of the dehydration of calcium oxalate monohydrate and the kinetics of the thermal decomposition of calcium carbonate. The reactions are studied under argon, at atmospheric pressure and under the reduced pressure of 2mm mercury, by following changes in sample weight as temperature is continuously increased to elevated temperatures to complete reaction, at the nominal rate of 5°C/min.

Under vacuum dehydration is found to commence at 80°C and go to completion at approximately 200°C. The rate of dehydration is resolved into low and high temperature regions of reaction. Below 120°C the energy of activation is estimated to be 20 Kcal/mole, and approximately 9 Kcal/mole, above 120°C, the high temperature stage of dehydration. The order of reaction above 120°C is determined to be unity. The results indicate that the rate controlling mechanism during the low temperature stage of dehydration is desorption from the surface of the particles, and volume diffusion for temperatures above 120°C.

The rate determining step of the deceleratory stage of the decomposition of calcium carbonate is attributed to the linear advance of the oxide interface into the interior of the particles. The energy of activation is found to be 53 Kcal/mole and the order of reaction 0.7, with respect to the quantity of calcium carbonate. In experiments with partially decomposed calcium carbonate it is shown that the presence of the calcium oxide phase, which has a cubic lattice in contrast with the rhombohedral structure of calcium carbonate, has decreased the temperature of decomposition. Although the energy of activation does not appear to be significantly altered during the acceleratory stage of decomposition, the order of reaction for this stage is essentially zero.

It is shown from theoretical considerations that one may expect an order of 0.67 for the deceleratory stage of this type solid state reaction. Furthermore, the derived relationships permit the calculation of the frequency of vibration of the lattice ions, which for calcium carbonate is found to be 10^{14} sec^{-1}. Previously other investigators assumed the value of 10^{13} sec^{-1}.

Microfilm $2.75; Xerox $5.80. 120 pages.

A KINETIC STUDY OF THE ACID CATALYZED HYDROLYSIS OF THE DI-POTASSIUM SALT OF DIAZOMALONIC ACID

(Order No. Mic 61-1967)

Charles Hoover Geisler, Ph.D.
The University of Nebraska, 1961

Adviser: Dr. Jay E. Taylor

The reaction velocity of the acid catalyzed hydrolysis of potassium diazomalonate has been studied at 25°C. over a pH range of 0 to 9. The effect of phosphate and acetate buffers has been observed as well as the effect of neutral salt at various hydrogen ion concentrations. The sensitivity of the reaction to perchloric acid catalysis has been studied over a pH range of approximately 0 to 8, the maximum being restricted by the extremely small rate of reaction at pH 9 or greater.

The results of the unbuffered studies using perchloric acid indicate that the hydrolysis of potassium diazomalonate is, for the most part, insensitive to specific hydrogen ion catalysis. The exception to this occurs in the extremely high acid region below pH 1, where the rate of hydrolysis is linearly related to the hydrogen ion concentration. For regions of pH greater than 3, the reaction rate is directly related to the concentration of the various species of diazomalonic acid which exist at any given pH. The observed rate for the uncatalyzed reaction using $HClO_4$ is given by:

$$k_{obs} = \frac{k_2(H^+)(K_1)}{(H^+)^2 + K_1(H^+) + K_1K_2}$$

Where K_1 and K_2 are the dissociation constants for diazomalonic acid, and k_2 is the specific rate for the uncatalyzed hydrolysis reaction.

The acetate buffer studies indicate that the acetate ion and the monovalent diazomalonate ion are the two reactive species involved in the hydrolysis reaction between pH 2 and 9. For the acetate ion catalysis the observed rate is given by:

$$k_{obs} = \frac{[k_1(OAc^-) + k_2]\, K_1(H^+)}{(H^+)^2 + K_1H^+ + K_1K_2}$$

where k_1 is the catalytic constant for acetate ion catalysis.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

The studies conducted using phosphate buffers gave results which could not be obtained from any derived expressions similar to those above. Calculations were based, first, on the assumption that $H_2PO_4^-$ was the catalytically active species and then on $HPO_4^=$ as the active species. In both cases the calculated values deviated considerably from the observed rate constants indicating that the degree of phosphate catalysis is not related to $(H_2PO_4^-)$ or $(HPO_4^=)$ or their sum, in any simple manner.

The results of the salt effect studies were, with one exception, all of the approximate degree predicted from theoretical considerations. The exception occurred in the region below pH 1 where addition of neutral salts resulted in a decrease in rate, indicating that the reactive form involved in the hydrolysis reaction is probably some positively charged species resulting from the addition of a proton to the neutral diazomalonic acid molecule.

Microfilm $2.75; Xerox $5.60. 112 pages.

PART I. THE VISIBLE SPECTRUM OF THE GALLIUM MONOHYDRIDE MOLECULE. PART II. AN EVALUATION OF THE CORIOLIS INTERACTION IN ASYMMETRIC TOP MOLECULES.

(Order No. Mic 61-2315)

Marshall Lloyd Ginter, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor K. Keith Innes

Part I.

An extensive emission system of GaH, in the region 5200-6400 A, has been obtained from a King furnace containing gallium metal and hydrogen at 1500 °C. Fourteen bands have been measured and analyzed on the assumption, previously made by Neuhaus, that they arise from a $^3\Pi_{1,0} - X^1\Sigma^+$ transition. The following constants, in agreement with the international nomenclature, have been determined (cm^{-1}):

	T_e	ω_e	$x\omega_e$	$y\omega_e$	B_e	α_e	γ_e	$D_e \times 10^4$
$^3\Pi_1^+$	17622.01	1631.17	58.22	-7.47	6.692	0.326	-0.0315	4.89
$^3\Pi_0^+$	17337.08	1640.54	62.72	-6.195	6.394	0.276	-0.0400	2.62
$X^1\Sigma^+$	0	1604.52	28.77	+0.360	6.137	0.181	-0.0005	3.37

A relatively weak fifteenth band has been analyzed as the 0-0 band of the transition $^3\Pi_2 - {}^1\Sigma^+$. Its band center and rotational constants are just those one would expect if each of the above constants, a_Ω, obeys the equation $a_2 - a_1 = a_1 - a_0$. Finally, diffuse features corresponding to transitions from an unstable state to the lowest three vibrational levels of the ground state have been observed between 4220 A and 4850 A.

Part II.

A means has been found of evaluating the "Coriolis interaction" in asymmetric top molecules by perturbation theory using the small vibrations approximation (i.e., products of the normal coordinates are taken as zero). The rigid rotator-harmonic oscillator approximate Hamiltonian has been taken as the zero order Hamiltonian which is perturbed by the following:

$$H'_{Coriolis} = -\sum_i \sum_{1,k} \frac{M_i}{I_{ii}} \zeta^i_{k1} Q_1 P_k \ .$$

Here, ζ^i_{k1} is the Coriolis coupling constant, I_{ii} is the ith principal moment of inertia, M_i is the ith component of angular momentum for the rigid rotor, Q_1 is the 1th normal coordinate, and P_k is the momentum conjugate to Q_k. The first non-vanishing Coriolis interaction is:

$$E^{J\tau V_1 \cdots}_{Coriolis} = \frac{2}{\hbar}[R\, W^\circ_{J\tau} + S\, J(J+1) + T\,(J,\tau|\, M_z^2 |\, J,\tau) + U\,(J,\tau|\, M_x M_y + M_y M_x |\, J,\tau) \ ,$$

where $W^\circ_{J\tau}$ is the J,τ-th rigid asymmetric top energy and the quantities R, S, T, and U contain no rotational quantum number (J,τ) dependence and are given by the following:

$R = (B^2B^{xx} - C^2B^{yy})/(B - C)$, $S = [BC(CB^{yy} - BB^{xx})]/(B - C)$, $T = \hbar^{-2}\{[(A - C)C^2B^{yy} - (A - C)B^2B^{xx}]/(B - C) + A^2B^{zz}\}$, and $U = \hbar^{-2}BCB^{xy}$, where

$$B^{ii'} = \sum_{k,1} \frac{\zeta^i_{k1}\,\zeta^{i'}_{k1}}{(\omega_k^2 - \omega_1^2)} \frac{(V_k + \frac{1}{2})(\omega_1^2 + 3\omega_k^2)}{\omega_k} \ .$$

The terms ω_k, V_k, and A, B, and C are angular frequencies, vibrational quantum numbers, and rotational constants, respectively. It should be noted that all energies (and rotational constants) have c. g. s. units.

The quantity $(J,\tau\,|\,M_xM_y + M_yM_x\,|\,J,\tau)$ has been found to vanish for all values of τ commensurate with $J \leqq 5$ and, therefore, probably vanishes for all values of J and τ. The quantities $(J,\tau\,|\,M_z^2|\,J,\tau)$ have been previously evaluated and appear in the literature.

Microfilm $2.75; Xerox $8.20. 179 pages.

ROTATIONAL ISOMERISM OF UNBRANCHED 1-ALKENES BY INFRARED SPECTRA

(Order No. Mic 61-2281)

Larry Allen Harrah, Ph.D.
University of Missouri, 1961

Supervisor: Edward E. Pickett

The infrared spectra of 1-butene and the higher 1-alkenes are investigated over the region from 10,000 $cm.^{-1}$ to 240 $cm.^{-1}$ for the purpose of establishing the existence of rotational isomerism about the 2,3 carbon-carbon bond. Two bands in the region 700 $cm.^{-1}$ to 500 $cm.^{-1}$ are observed which may be assigned to the ethylenic twisting vibrations from two nonequivalent rotational isomers. The infrared spectra of the higher 1-alkenes in the crystalline solid state are shown to be consistent with this assignment.

A potential function for rotation about the 2,3 carbon-carbon bond in 1-butene is formulated on the basis of

combined steric and resonance effects. The calculation of the steric part of this hindering potential is made using the empirical relationship of Aston, et al.,[1] and the resonance contribution is estimated by comparing the spectrum of 1-butene to the spectra of 3-bromo-, 3-iodo-, and 3-cyanopropene.

The high resolution infrared spectrum of gaseous 1-butene is presented over the range from 10,000 $cm.^{-1}$ to 240 $cm.^{-1}$, together with the assignments of the fundamental vibrations of the two isomeric forms of this molecule. The vapor state spectrum of 1-butene is subsequently interpreted on the basis of these assignments. The infrared spectra of the liquid states of 1-butene, 3-bromopropene, 3-iodopropene, and 3-cyanopropene in the range 4000 $cm.^{-1}$ to 500 $cm.^{-1}$ are presented for comparison.

Estimations of the ethyl-vinyl torsional frequencies for the two isomeric configurations are made both on the basis of the proposed potential function and on the basis of the calculated entropy as compared to the observed entropies of 1-butene at four temperatures. The agreement between the thermodynamic values and those calculated from the proposed potential function is only fair.

The information derived from this study established the existence of two nonequivalent rotational isomeric conformations of 1-butene and the higher 1-alkenes formed by rotation about the 2,3 carbon-carbon bond. The stable configurations indicated are a planar trans form stabilized by resonance and two spectroscopically identical forms in which the ethyl group is rotated about the 2,3 carbon-carbon bond $\pm$ 100° from the extended trans configuration.

The low temperature cell used in obtaining the spectra of the crystalline 1-alkenes is of our own design and is described in detail.

1. Aston, J. G., Isserow, S., Szasz, G. J., and Kennedy, R. M., J. Chem. Phys., 12, 336, (1944).

Microfilm $2.75; Xerox $5.20. 104 pages.

HEATS OF FORMATION OF COORDINATION COMPOUNDS

(Order No. Mic 61-2380)

Hidehiko Kido, Ph.D.
The Pennsylvania State University, 1961

Many students of coordination compounds have commented on the need for data concerning the heats of formation of coordination complexes instead of the free energies of formation (calculated from equilibrium constants) as commonly determined. For one thing, heats of reaction are proportional to bond energies; for another, a knowledge of both the free energies and heats of reaction permits one to evaluate the importance of the entropy contribution to the stability of the complex. The data presently available on heats of reaction have been obtained by determining equilibrium constants at a variety of temperatures or by direct calorimetric measurements. The present investigation was initiated to determine if the method of enthalpy titrations might be equally useful for nono- and bidentate ligands. Results are reported here for ethylenediamine and its homologues with a variety of metal ions.

Although the method of entropy titrations is rapid, it suffers from the fact that it is a relative and not an absolute method. Hence its successful use depends upon careful and frequent calibration. For the results reported here a calibration (passage of a measured quantity of electricity through a resistance heater) was made in connection with each determination. The technique of enthalpy titrations requires that one of the reactants, either metal ion solution or ligand solution, be fed at a constant rate into the other until a considerable excess has been added. Hence, one can determine the heat evolved during either the association of the metal ion with a single ligand (metal ion in excess) or the association of the metal with the maximum number of ligands (ligand in excess). Thus, if there are more than two consecutive reactions the heats of the individual association reactions cannot be determined. In practice, this limitation is not as serious as might be supposed.

In this work, the measurements of the heats of protonation of the several amines (aliphatic monoamines, heterocyclic monoamines and ethylenediamine and its homologues) and the heats of reaction for those amines with several cations, especially silver and mercury (II) ions were carried out using enthalpy titrations as described above. Furthermore, the heats of neutralization of weak acids, such as the hydroxyquinones and γ-pyrones in several dioxane-water mixtures were measured.

For primary amines, the ratio $\Delta H/\Delta F$ is ca. 0.91 and for pyridine and the picolines ca. 0.75. For the aliphatic diamines including piperazine and homopiperazine the ratio $(\Delta H_1 + \Delta H_2/\Delta F_1 + \Delta F_2)$ is about the same as the ratio for monoprimary amines although both N- and C-substitution seem to cause variation from this ratio.

The same method has been used to determine heats of formation of metal-amine complexes. The results are better than have been obtained previously by other methods. The heats of coordination are considered on the basis of differences in base strength of the amines and other factors, especially configurations of the cyclic diamines and the size of the coordinated ions.

Using the ΔH values determined here and previously determined values of ΔF, both ΔS values and bond energies have been calculated for metal-nitrogen bonds. In general, the entropy contribution to the stability of the complexes is favorable in all cases although to a different extent with different ligands and the same cations; with the formation of the first, second, etc., complexes; and with different metal ions. The bond energies for a given metal to nitrogen bond are constant to a remarkable degree (greatest variation 6 per cent, average 3.6 per cent).

The method of enthalpy titrations has been used for determining heats of neutralization in 50, 60 and 75 percent v/v dioxane-water solutions. The presence of dioxane causes very little change in the heat of neutralization of a strong acid by a strong base.

Further work in this general field will be very rewarding. Several fruitful areas for such investigations are noted. Microfilm $2.75; Xerox $5.40. 109 pages.

THE RADIATION INDUCED EXCHANGE OF CARBON BETWEEN ETHANE AND METHYL AMINE

(Order No. Mic 60-6020)

Philip Shepard Lamprey, Ph.D.
University of New Hampshire, 1961

The idea for this work actually grew out of work previously done by Wolfgang, Anderson, and Dodson.[1] They determined the % of apparent C-N bond retention when doubly labelled C^{14} ethane decays. There is a probability that when such a decay occurs, the recoil imparted to the molecule by beta emission is sufficient to break the C-N bonding, thus decomposing the molecule of methyl amine, the product expected if no bond breaking occurs. In their work, Wolfgang et al. consider radiation induced exchange of C^{14} from ethane to methyl amine as being negligible. However, if such an exchange does occur, it would affect the results of such bond retention studies.

It was noted in the data of Wolfgang et al. that as the time of self decay of doubly labelled C^{14}-ethane samples increases, the experimentally determined apparent bond retention decreases. This could be due to radiation decomposition of methyl amine.

The work described in this thesis was essentially as follows:

1. A sample of C^{14}-ethane, which had been standing for 4.5 years, was analyzed and apparent bond retention calculated as in the method of Wolfgang et al.

2. Three series of C^{14}-ethane, methyl amine samples were irradiated with a cobalt-60 irradiator, the construction of which is described in this thesis. The methyl amine of these samples was then analyzed for C^{14} content. Series 1 samples had varying times of irradiation while C^{14} ethane and methyl amine concentrations were constant. Series 2 had methyl amine concentration variable with C^{14} ethane content and time of irradiation constant. Series 3 had C^{14}-ethane content varied while methyl amine content and time of irradiation were constant.

3. Irradiated samples of C^{14}-ethane and methyl amine were analyzed on a gas chromatograph employing an ionization chamber detector to indicate radioactive materials. A column packing of o-toluidine, which was previously found to separate ethane, methyl amine, dimethyl amine, and ethyl amine from each other, was used.

The results of these investigations were as follows:

1. The analysis of the 4.5 year C^{14} ethane sample resulted in a calculated bond retention of 18.5%, which is in line with the observation that apparent bond retention decreases with increased grow-in time.

2. Series 1 showed that carbon-14 exchange from ethane to methyl amine is directly proportional to time of irradiation (or irradiation dose). Series 2 showed that at lower methyl amine concentrations, carbon-14 exchange increases as methyl amine concentration increases; at higher methyl amine concentrations, carbon-14 exchange decreases as methyl amine concentration increases. Series 3 showed that at lower C^{14} ethane concentrations, carbon-14 exchange is second order in ethane, and at higher ethane concentrations, carbon-14 exchange is first order in ethane.

3. The gas chromatographic sample analysis showed the only detectible radioactive materials in irradiated samples to be the original ethane and methyl amine, the product of carbon-14 exchange.

The following mechanism for the exchange is proposed and shown to be consistent with the experimental results:

$$E \xrightarrow{\gamma} E^* \quad (1)$$

$$E^* + M \longrightarrow M^* + E \quad (2)$$

$$E^* + E \longrightarrow E + E^* \quad (3)$$

$$E^* \longrightarrow C^{14}H_3. \quad (4)$$

$$M \xrightarrow{\gamma} M^* \quad (5)$$

$$M^* \longrightarrow CH_3. + NH_2. \quad (6)$$

$$C^{14}H_3. + NH_2. \longrightarrow C^{14}H_3NH_2 \quad (7)$$

E represents ethane.

M represents methyl amine.

* denotes an excited or ionized state.

The above is not the only possible mechanisms. Further work is necessary to prove a definite mechanism.

Since the exchange has been found experimentally, it is possible that it could have affected the results of Wolfgang et al. Since however, the experimental conditions in this work differed somewhat from those experienced by the samples of Wolfgang et al., no definite conclusions can be drawn regarding the effect of carbon-14 exchange on the bond retention studies.

1. Wolfgang, Anderson, and Dodson, J. Chem. Phys., 24 16 (1956).

Microfilm $2.75; Xerox $4.20. 77 pages.

KINETICS AND MECHANISM OF THE PROTONOLYSIS OF THE TIN-HYDROGEN BOND

(Order No. Mic 60-6690)

Philip Leo Levins, Ph.D.
University of New Hampshire, 1961

The kinetics of the acid-catalyzed reaction of tri-n-butyltin hydride in methanol (equation 1) has been shown

$$Bu_3SnH + HA \rightarrow H_2 + Bu_3SnA \quad (1)$$

to fit the rate equation

$$\text{rate} = C_{Bu_3SnH} \sum_i k_i C_{HA_i} \quad (2)$$

where i represents any proton donor. General acid catalysis for this reaction is thus demonstrated. The data was correlated by the Brönsted relationship and the equation for the least squares line is

$$\log\left(\frac{k}{p}\right) = 0.580 \log\left(\frac{q}{p}K\right) + 2.43 \quad (3)$$

The kinetics of the base-catalyzed reaction (equation 4) has been shown to fit the rate equation (5) and is believed to proceed by a pre-equilibrium formation of a tin hydride – methoxide intermediate.

$$Bu_3SnH + CH_3O^- + CH_3OH \rightarrow H_2 + Bu_3SnOCH_3 + CH_3O^- \quad (4)$$

$$\text{rate} = kC_{Bu_3SnH}C_{CH_3O^-}C_{CH_3OH} \quad (5)$$

The results obtained upon hydrogen isotopic substitution on both the hydride and the acid species are listed in Table I. The results demonstrate a number of factors. (1) In addition to the dependence of the acid isotope effect on acid strength, the Sn-H isotope effect is also dependent on the acid strength, (2) a rate-determining proton transfer is clearly indicated for both the acid- and base-catalyzed reactions, (3) a significant inverse isotope effect in the solvent reaction is observed for the Sn-H bond and (4) a smaller solvent isotope effect is obtained for the transfer of a proton to a negatively charged substrate in the base reaction than to a neutral substrate in the solvent reaction.

Table I

catalyst	$(k_{SnH}/k_{SnD})_{CH_3OH}$	$(k_{OH}/k_{OD})_{SnH}$
methoxide	1.01	2.84
perchloric acid	1.15	3.5
o-nitrobenzoic acid	0.905	5.26
solvent	0.44	6.06

A three-center transition state involving an electrophilic attack of the acid on the Sn-H will account for the observed experimental results in the acid catalysis.

Microfilm $2.75; Xerox $6.80. 142 pages.

THE IONIC NATURE OF MOLTEN ALKALI CARBONATES

(Order No. Mic 60-4528)

Max R. Lorenz, Ph.D.
Rensselaer Polytechnic Institute, 1960

Supervisor: George J. Janz

This research is concerned with the study of the physicochemical and electrochemical properties of molten alkali metal carbonates. Relative to the properties of pure Li_2CO_3, Na_2CO_3 and K_2CO_3, the thermal stability, surface tensions, densities, molar volumes and the electrical conductances have been determined using controlled CO_2 atmospheres at temperatures up to 1000°C. Surface tensions and molar volumes for the binary system, Na_2CO_3-K_2CO_3 were similarly determined.

As part of this study the phase equilibria for binary and ternary mixtures of these carbonates were explored to determine the composition and temperature of low melting mixtures accurately. The lowest melting mixture was found in the ternary system of composition, (mole %) Li_2CO_3, 43.5; Na_2CO_3, 31.5; and K_2CO_3, 25.0, m.p. 397°C.

The thermal dissociation of carbonates to oxides and CO_2 was determined by a dynamic method. The surface tensions and densities were measured simultaneously in an apparatus developed for that purpose in this research. Precise determination of the electrical conductances were made possible by use of a cell and assembly, having as materials of construction single crystal MgO and gold-palladium alloy.

The equivalent conductances at 10% above the absolute melting point of Li_2CO_3, Na_2CO_3 and K_2CO_3 are 99.0, 91.0 and 88.5 $ohms^{-1}\,cm^2\,equiv.^{-1}$ respectively. The temperature dependence of the conductances can be expressed by an Arrhenius type rate equation to a good approximation and the activation energies for equivalent conductance of Li_2CO_3, Na_2CO_3 and K_2CO_3 are 4.40, 4.14, and 4.64 kcal. $equiv.^{-1}$ respectively. Surface tensions at 10% above the absolute melting point are, Li_2CO_3, 240; Na_2CO_3, 205.9; and K_2CO_3, 161.7 dynes/cm. These results are understood if the carbonates form highly ionic melts i.e. kinetically free ions.

The nearly ideal behavior in the binary system Na_2CO_3-K_2CO_3 with regard to surface tensions and molar volumes indicates the lack of strong interactions leading to association complexes.

An interpretation of these results is discussed in the light of a model for carbonates in which the predominant ionic species are M^+ and $CO_3^=$ in the molten state, and in which the carbonate ions contribute more predominantly than the M^+ species to electrical transport in the process of conductance.

Microfilm $2.75; Xerox $8.20. 177 pages.

INDUCTIVE AND ISOTOPE EFFECTS IN GAS PHASE LEWIS ACID-BASE EQUILIBRIA

(Order No. Mic 61-2385)

Peter Love, Ph.D.
The Pennsylvania State University, 1961

The purpose of this investigation was to utilize the gas phase equilibrium

$$(CH_3)_3B - NR_1R_2R_3 \rightleftharpoons (CH_3)_3B + NR_1R_2R_3 \quad (1)$$

in order to: (1) investigate more thoroughly the applicability of Taft's σ^* parameters which were determined from reactions in solution to this gas phase system; (2) determine the secondary hydrogen isotope effect for the Lewis acid trimethyl boron on the thermodynamic properties of the system, and to note the relationship of this effect to the theory of hyperconjugation; and (3) investigate new analytical methods for the analysis of equilibrium data which are more accurate and convenient than those in current use.

The dissociation pressure of the equilibrium (1) was measured as a function of temperature essentially following the tensiometric procedure of Brown.[1,2] The Mangelsdorf method of calculating the convergence limit of the dissociation pressure versus temperature curve was used when the degree of dissociation was equal to or greater than nine tenths.

The secondary hydrogen isotope effect in trimethyl boron has been measured for the dissociative gas phase equilibria of trimethyl boron-trimethylamine. The isotope effect, given as K_h/K_d, was found to be 1.22 ± 0.01 at 100°C. Dissociation is favored for the light addition compound. This result is consistent with the hyperconjugative theory of the secondary isotope effect.

The Taft equation has been applied to the gas phase dissociative equilibria of trimethyl boron-alkylamine for a series of primary aliphatic amines having a wide range of polarity. The σ^* parameters correlate most of the data. However, for amines such as 2-methoxyethyl and 3-methoxypropylamine, the correlation fails. This deviation is attributed to an intramolecular field effect. Ammonia is a much weaker base than is predicted by the Taft equation. This decreased basicity may be due to an effective diminution of the potentially bonding sp^3 hybridized orbital as a result of the high inversion frequency of ammonia.

The ρ^* value correlating the enthalpies of dissociation with Taft's inductive parameters was found to be -3.3 kcal./σ^*. This ρ^* value was found to lead to an excellent correlation of the literature values of the enthalpies of reaction for the Lewis acid-base equilibria involving m- and p-methyl substituted pyridines in nitrobenzene solution.

1. H. C. Brown and M. Gerstein, J. Am. Chem. Soc., 72, 2923 (1950).
2. H. C. Brown, M. D. Taylor, and M. Gerstein, J. Am. Chem. Soc., 66, 431 (1944).

Microfilm $2.75; Xerox $5.20. 101 pages.

THE OXIDATION OF TETRABORANE

(Order No. Mic 61-1686)

Kenneth Hills Ludlum, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: W. H. Bauer

An investigation of the explosive oxidation of tetraborane and the partial oxidation of tetraborane was undertaken. The explosive oxidation of tetraborane was studied in Pyrex glass bulbs of different diameters and with the added inert gases helium and nitrogen as well as in Pyrex glass bulbs packed with glass wool. A study of the explosive reaction which occurred when lead tetraethyl was added as an inhibitor was also undertaken in Pyrex glass bulbs. The partial oxidation of tetraborane, mixtures of tetraborane and diborane, and tetraborane and argon was studied in an infrared gas reaction cell. The partial oxidation reaction was brought about by the controlled slow addition of oxygen to the reactant gases contained in the infrared reaction cell.

Mixtures of tetraborane with oxygen, and with oxygen and inert gas were prepared at known pressures and temperatures in the reaction bulbs; these mixtures exploded on heating. The data obtained indicated a branching chain reaction with chain initiation in the gas phase and chain breaking on the wall of the vessel. The entire range of pressures and temperatures investigated shows the behavior generally attributed to the first explosion limit of a branching chain reaction. Lead tetraethyl was found to inhibit the reaction erratically and in some cases prevented explosion.

The partial oxidation of tetraborane was brought about by the slow addition of oxygen to tetraborane in the infrared gas reaction cell. Upon admission of oxygen, a reaction occurred which produced diborane, partial oxidation product, hydrogen and boric acid anhydride. The main reaction can be represented by the stoichiometric equation

$$B_4H_{10} + \frac{3}{2}\,O_2 \rightarrow B_2H_6 + B_2H_2O_3 + H_2$$

while evidence is presented that the $B_2H_2O_3$ slowly reacts as follows, at the temperatures and conditions studied

$$B_2H_2O_3 \rightarrow B_2O_3 + H_2.$$

Mixtures of tetraborane and diborane to which oxygen was slowly added reacted similarly except that the net change in the moles of diborane in the reaction was much less than expected.

The inert gas argon had no effect on the system under the conditions studied.

When a few millimeters of water vapor or diethyl ether were present in tetraborane, no reaction occurred on the slow addition of oxygen.

A proposed mechanism for the oxidation of tetraborane follows:

$$B_4H_{10} \underset{R}{\overset{F}{\rightleftarrows}} BH_3 + B_3H_7$$

$$BH_3 + O_2 \xrightarrow{2} BH_3O + O$$

$$O + B_4H_{10} \xrightarrow{3} BH_3O + B_3H_7$$

$$BH_3O + B_4H_{10} \xrightarrow{4} B_2H_6 + B_3H_7O$$

$$B_3H_7O + O_2 \xrightarrow{5} B_2H_2O_3 + BH_3 + H_2$$

$$B_2H_2O_3 \xrightarrow{6} B_2O_3 + H_2$$

$$2\,BH_3 \xrightarrow{7} B_2H_6$$

$$B_3H_7 \xrightarrow{8} \text{Destruction at surface}$$

$$BH_3O \xrightarrow{9} \text{Destruction at surface}$$

$$O \xrightarrow{10} \text{Destruction at surface}$$

Microfilm $2.75; Xerox $5.60. 114 pages.

INORGANIC ELECTROLYTES IN ANHYDROUS ACETONITRILE

(Order No. Mic 61-1687)

Arthur E. Marcinkowsky, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: George J. Janz

This research is concerned with the properties of inorganic electrolytes dissolved in anhydrous acetonitrile. Insights relating to ionic interactions, solute-solvent interactions and solute-solute interactions are of particular interest. These effects are usually more pronounced in solvents of low or intermediate dielectric constant which also possess marked polar characteristics. Acetonitrile is especially suited as a solvent in this role as it possesses both these characteristics; at 25°C, it has a

dielectric constant of 36 and a dipole moment of 3.37 Debye units.

Through the selection of several inorganic salts it was possible to differentiate this work into three broad phases. These may be defined as (i) the region of dilute concentration in which potassium iodide was studied, (ii) the region of high concentration in which silver nitrate was studied, and (iii) systems which exhibit pronounced "complex"-ion behavior for which the cobaltous halide salts were investigated.

The method of electrical conductance was basic to all phases of this study. The concepts of the Debye-Hückel-Onsager theory for the very dilute region of concentration were studied using KI as the solute. Extensions of this theory to include the higher concentrations have also been developed and advanced. To evaluate these concepts $AgNO_3$ was selected as the solute. The properties of the cobaltous halides as solutes in acetonitrile were similarly investigated by electrical conductance and, in addition, by the technique of spectrophotometry. The combination of these two experimental methods yielded insights as to the nature of the ionic species and the various interactions taking place in such complex systems.

Potassium iodide was investigated in the dilute region of concentration from 9×10^{-5} to 5.6×10^{-2} eq/1 and at three temperatures, 0°, 25° and 35°C. The limiting equivalent conductance, Λ_0, for this salt was determined at each temperature. The magnitude of this parameter is of theoretical significance; it is a measure of the ionic mobilities assuming ion-ion interactions have been reduced to zero, i.e., the maximum mobility. A comparison of the results in anhydrous acetonitrile and in water is as follows:

KI	0°C Λ_0	25°C Λ_0	35°C Λ_0
CH_3CN	145.9	186.7_5	204.8
H_2O	82.1	150.5_3	180.7_6

In the dilute region of concentration, KI is found to behave as a strong electrolyte, with a limiting equivalent conductance greater than in aqueous solutions. Walden's rule was observed to hold at the three temperatures studied. This made possible the calculation of the limiting ionic mobilities. The summary of results below gives these values and the known ionic mobilities in aqueous solutions:

T °C	0		25		35	
Solvent \ Ion	K^+	I^-	K^+	I^-	K^+	I^-
CH_3CN	67.3	79.2	85.9	101.0	94.3	110.9
H_2O	40.7	41.4	73.50	76.84	88.21	92.39

Inspection shows clearly the enhanced mobility in anhydrous acetonitrile solutions. The decreased mobilities in aqueous solutions may be attributed, in part, to stronger ion solvent interactions (solvation) relative to anhydrous acetonitrile solutions.

The conductivity, density and viscosity of solutions of silver nitrate in acetonitrile were determined at 25°C and covered a concentration range from 10^{-2} to 6 eq/1. The Wishaw-Stokes equation:

$$\Lambda = \left(\Lambda_0 - \frac{\beta\sqrt{C}}{1 + B\mathring{a}\sqrt{C}}\right)\left(1 - \frac{\delta\sqrt{C} \times F}{1 + B\mathring{a}\sqrt{C}}\right)\eta_0/\eta \ ,$$

in which both ion-size and viscosity corrections have been introduced to extend the range of the treatments based on the interionic attraction theory (Debye-Onsager) to higher concentration ranges, was evaluated over this entire concentration range. A comparison with $AgNO_3$ in aqueous solutions at this temperature and similar concentration range was possible. Deviations from the Wishaw-Stokes equation are discussed; they may be attributed, in part, to such factors as ion-aggregate (e.g., ion-pair) formation and incomplete dissociation of the solute.

From the density data apparent and partial molal volumes were also calculated for solutions above one molar in the $AgNO_3$-CH_3CN system. It could be ascertained from these calculations that the features of solvent "structure" in acetonitrile are markedly different than in water.

One of the methods for evaluation of primary ion-solvent interactions such as solvation is based on the measurement of viscosity. From these studies in anhydrous acetonitrile, it is found that the solvation number (i.e., ratio of solvent molecules/solute species) is 3.7 for the entire concentration range up to 5 eq/1 of $AgNO_3$. Above 5 eq/1 this method apparently breaks down. A separate calculation shows that the ratio, solvent molecules/solute molecules, for the whole system is less than 3 at 6 eq/1 $AgNO_3$. Relative to the concentration range up to 5 eq/1, the solvation number, 3.7, may be interpreted as a primary solvation number, i.e., a measure of the number of solvent molecules in the first solvation sheath in which the solvating molecules have lost both translational and rotational degrees of freedom. A comparison of the viscosity data for anhydrous acetonitrile and aqueous solutions of silver nitrate:

$AgNO_3$, eq/1	0	0.1	0.5	1	3	6
η (cp.) CH_3CN	0.359_4	0.383	0.473	0.615	1.80	10.40
η (cp.) H_2O	0.8903	0.8983	0.9170	1.048	1.164	1.683

is of interest relative to these considerations. The very marked increase with increasing concentrations in both systems indicates strong solvent-ion and solvent-solute interactions.

For the cobaltous halide-acetonitrile systems, strong solute-solvent interactions can be anticipated from theoretical considerations. The electrical conductance of $CoCl_2$ and $CoBr_2$ was investigated, accordingly, at three temperatures, 0°, 25° and 35°C, and at concentrations 10^{-4} to 5×10^{-2} eq/1. Several interesting features were noted. A negative temperature coefficient for conductance was present. Secondly, at each temperature only a small variation in the value of the conductance was found for a hundredfold change in concentration of the solute (i.e., 5×10^{-2} to 5×10^{-4} eq/1). Thirdly, solid substrates of empirical formula $CoCl_2 \cdot 3\ CH_3CN$ and $CoBr_2 \cdot 3\ CH_3CN$ were isolated from saturated solutions of the respective salts.

Spectrophotometric measurements for both the cobaltous chloride and bromide were carried out at 25° and 35°C. Because of the high optical density of these solutions measurements were restricted to the dilute region

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of concentration up to approximately 5×10^{-3} moles/l. The expression relating optical density with concentration is found to be:

$$D_0 = a\,C_0 \pm b\,C_0^2 = \epsilon\,C_0 .$$

Theoretical considerations based on the various ionic species and mass law equilibria show that a simple model in accord with the spectrophotometric results may be advanced in which the predominant species in anhydrous acetonitrile solutions are: molecular CoX_2, ionic species, Co^{++} and $CoX_4^{=}$, and a dimeric species, $(CoX_2)_2$.

The results from the conductivity measurements, analysis of the substrates, spectrophotometric studies, and Ligand-Field Theory considerations are discussed relative to this model. It is apparent that both solute-solvent and solute-solute interactions contribute to the ionic processes in these solutions. The interactions may be summarized by the expression:

$$2\,CoX_2 \rightleftarrows \underset{A}{[Co(CH_3CN)_6^{++}\ CoX_4^{=}]}$$

and

$$\underset{A}{[Co(CH_3CN)_6^{++}\ CoX_4^{=}]} \rightleftarrows \underset{B}{Co(CH_3CN)_6^{++}} + \underset{C}{CoX_4^{=}} \qquad \text{(i)}$$

or

$$[Co(CH_3CN)_6^{++}\ CoX_4^{=}] + 2\,CH_3CN \rightleftarrows Co(CH_3CN)_6^{++} + \underset{D}{CoX_4(CH_3CN)_2^{=}} \qquad \text{(ii)}$$

where the dimeric species (A), an ion-pair, is in equilibrium with molecular CoX_2 and solvated cationic species (B), and anionic species (C). The configuration of the anionic species, in accord with Ligand-Field concepts, may be tetrahedral or tetragonal bipyramidal. Interaction with additional solvent as in (ii) above is proposed to give a solvated anionic species (D) in which the two polar acetonitrile molecules make possible the distorted octahedral ionic configuration. The structural evidence for these species based on other work, such as magnetochemistry, is reviewed.

The importance of solute-solvent interactions relative to the properties of electrolytes in nonaqueous polar organic solvents is clearly evident from the investigations of this thesis research.

Microfilm $2.90; Xerox $10.15. 224 pages.

AN ADIABATIC DEMAGNETIZATION STUDY OF PALLADIUM AND PALLADIUM HYDRIDE

(Order No. Mic 61-2388)

Hanna Judeh Maria, Ph.D.
The Pennsylvania State University, 1961

An attempt has been made to obtain nuclear cooling with protons by the method of adiabatic demagnetization. A two stage process was used in which the nuclear stage was composed of hydrogen absorbed in palladium. The behaviour of pure palladium was investigated in preliminary experiments to determine whether there was any observable effect due to the palladium alone. Such an effect was not to be expected because the nuclear moment of Pd^{105}, which has an angular momentum of 5/2 and occurs in natural palladium in 22.6% is very small.

No observable nuclear cooling was obtained with pure palladium upon demagnetization from starting temperatures of about 0.01°K and starting fields up to twelve kilogauss.

Palladium hydride showed a large energy evolution below 1°K. The energy evolution was attributed to conversion between the three symmetry varieties of tetrahedral PdH_4. Marked reductions in the rate of energy evolution were obtained by cooling the specimen slowly from liquid nitrogen to liquid hydrogen temperatures and then maintaining it at 20°K for various lengths of time. The variation in the rates was analyzed kinetically and the process was found to follow a second order rate equation. The kinetic analysis also enabled a calculation of the equilibrium rotational energy for the system at 4°K.

On the basis that at temperatures of 4°K and below only the first two energy levels need be considered, the separation energy between these two levels was found to correspond to 25-30°K.

The large energy evolution in the specimen made the observation of any nuclear cooling impossible.

In addition, the results of other investigators on nuclear cooling with copper were confirmed. Final temperatures in the range of 10^{-4} to 10^{-5} degrees were obtained. The dependence of the final temperature on the ratio of the initial magnetic field to the initial temperature and the characteristic time for the decay of the nuclear susceptibility after demagnetization were in agreement with the results of these investigators.

Microfilm $2.75; Xerox $4.20. 79 pages.

A THEORY FOR CONFORMATIONS IN ISOTACTIC POLYMERS; A MARKOV PROCESS.

(Order No. Mic 61-2704)

Victor Eugene Meyer, Ph.D.
Michigan State University, 1961

Major Professor: Jack B. Kinsinger

An equation has been derived which relates the mean square end-to-end length of an isotactic vinylic hydrocarbon-type chain to the detailed geometry of the chain. The equation is restricted to long linear chains with regular head-to-tail structure which can be represented by a diamond lattice model. The chain bonds are all considered to have constant and equal length, and are connected at the tetrahedral valence angle. The rotational angle, as defined by any three consecutive bonds, is restricted to the trans and two gauche conformations. Furthermore, the bonds are considered to be statistically independent, which allows the problem to be solved by Markov chain statistics. The mean square length is expressed as a function of the probabilities of finding the bonds in their respective trans and gauche conformations.

The mean square end-to-end length of a polymethylene-type chain has also been calculated by the methods indicated above. The equations obtained are discussed relative to pertinent experimental data. It is concluded that

"crystalline" polymers tend to retain their crystalline state "conformations" in their "unperturbed" states.

Microfilm $2.75; Xerox $4.60. 88 pages.

SOLUBILITY OF XENON IN LIQUID METALS

(Order No. Mic 61-2218)

Chittaranjan Mitra, Eng.Sc.D.
Columbia University, 1959

The solubility of xenon has been measured in three different liquid metals, namely, bismuth, sodium and mercury. The data on mercury are of lesser accuracy than those on bismuth and sodium. The observed temperature effects are as follows:

$$\text{for Xe/Bi}: \quad -\log x_1 = 7.019 + \frac{1071}{T}; \quad \text{probable error in } x_1 = 3.5\%.$$

$$\text{for Xe/Na}: \quad -\log x_1 = 3.248 + \frac{522}{T}; \quad \text{probable error in } x_1 = 2.0\%.$$

$$\text{for Xe/Hg}: \quad -\log x_1 = 0.2 + \frac{2565}{T}; \quad \log x_1 \text{ off by a factor of two.}$$

where x_1 = atom fraction xenon in solution at 1 atm.

T = absolute temperature, °K

The measurement on bismuth was made by two separate methods. In the first, bismuth was saturated with radioactive xenon, then frozen to a solid, which was then dissolved in nitric acid to liberate the dissolved gas for radio-active counting. The second method consisted of transferring the liquid bismuth saturated with xenon to a vessel evacuated of xenon at the time of transfer. Then the activity of the desorbed xenon was determined. This method was also employed for mercury. For sodium a third method was invoked. A frozen quantity of saturated sodium was remelted in a completely evacuated vessel and the activity of the liberated xenon measured.

The measured solubilities and their temperature coefficients cannot be predicted by available theories. A semi-empirical method for the prediction of the solubility of xenon in liquid metals was developed.

Microfilm $2.75; Xerox $6.00. 125 pages.

DIELECTRIC RELAXATION TIMES AND STRUCTURES OF SOME NONRIGID MOLECULES

(Order No. Mic 61-2000)

William Paul Purcell, Ph.D.
Princeton University, 1960

The Debye treatment of dielectric relaxation and several methods for treating the data are outlined. A graphical method for calculating two relaxation times and A. Budó's theory for treating nonrigid molecules are described.

The behavior of the methylene chloride group is characterized by the measurements of the dielectric constants and losses at 1.2, 3.2, 10, 25 and 50 cm. for benzyl chloride, α,α'-dichloro-p-xylene and bis(chloromethyl)durene in benzene solution. The resulting absorption curve for benzyl chloride is resolved into two peaks corresponding to over-all molecular and group relaxation. The short relaxation time for benzyl chloride is compared with the relaxation time of α,α'-dichloro-p-xylene, which should relax primarily by intramolecular rotation. The single absorption peak and long relaxation time for the durene compound indicate molecular orientation as the predominant mechanism of relaxation. The dipole moment for bis(chloromethyl)durene is measured and, upon analysis, the value is found to be consistent with the moments previously found for benzyl chloride amd α,α'-dichloro-p-xylene.

The relaxation times of 4,4'-bis(dimethylamino)benzophenone, 2,4,6-trinitroanisole, 2-amino-4methylpyridine, and N,N-dimethyl-p-nitroaniline have been measured in benzene solution in order to determine what influence, if any, the methoxy, amino, or dimethylamino group has upon the relaxation and how the rotation of the group may be hindered by structural factors. The relaxation times give no positive evidence of intramolecular group rotation in these molecules, but the considerable differences between the infinite-frequency dielectric constants and the squares of the refractive indices show high-frequency absorption due to such oscillational or rotational motion. The moment value 4.99×10^{-18} is found for 4,4'-bis(dimethylamino) benzophenone.

The relaxation times have been measured for bis(o-nitrophenyl)ether, bis(p-nitrophenyl)ether, bis(p-nitrophenyl)methane and cyclohexyl phenyl ether in benzene solution and for bis(p-bromophenyl)ether in nujol solution. The values found for the relaxation times support the hypothesis of a shift of charge accompanying rotation of a phenyl ring about its bond to the rest of the molecule as the mechanism of intramolecular relaxation. The dipole moment found for cyclohexyl phenyl ether is 1.55.

Isotactic, atactic and syndiotactic forms of polymethylmethacrylate have been examined by infrared spectroscopy, X-ray diffraction, and by dielectric measurements in the kilocycle and microwave range. In the order isotactic, atactic, syndiotactic the following trends are found: decreasing molar polarization and average dipole moment, increasing relaxation time, and increasing distribution of relaxation times. The X-ray data showed the isotactic material to be more easily crystallizable than the syndiotactic and it, in turn, more readily crystallizable than the atactic. The above results are analysed in terms of the degree of freedom of orientation of the monomer units. All the evidence indicates greater freedom of orientation in the isotactic form and less freedom in the syndiotactic with the atactic being intermediate.

The dielectric constants and losses of a polyester of 1,2-propylene glycol and adipic acid have been measured at 20° and at wave lengths of 1.2, 3.2, 10, 25 and 50 cm., and 575 m. in benzene solution. The data may be represented by two parameters, a most probable relaxation time and a distribution factor, two relaxation times, or a distribution of relaxation times between two limiting values.

The values obtained for the relaxation times are close to those previously found for long-chain fatty acid esters and correspond to relaxation by twisting of short segments containing carboxyl groups around bonds in the chain. A value 1.57 obtained for the effective dipole moment of the COOC group as compared to 1.9 in a small monoester indicates some restriction of rotation around the bonds because of mutual repulsion between the polar groups.

Microfilm $2.75; Xerox $6.60. 137 pages.

HEAT CAPACITY AND RELATED THERMODYNAMIC PROPERTIES OF Ta_2H AND $DyCo_5$

(Order No. Mic 61-1885)

William George Saba, Ph.D.
University of Pittsburgh, 1961

Supervisor: Professor William E. Wallace

A study of the heat capacities of Ta_2H and $DyCo_5$ was made in the temperature range 12°K to 550°K. In the case of Ta_2H, these data were obtained for the purpose of (1) bettering the present understanding of the nature of the order-disorder transformations which occur in the Ta-H system, (2) assisting in the elucidation of the structures of the α and β forms of Ta_2H. The measurements on $DyCo_5$ were initiated in an effort to reveal the energetics associated with the magnetic anomalies at about 360°K and 125°K.

The Ta_2H sample was prepared by hydrogenating a sample of Ta used in previous measurements. The $DyCo_5$ sample was prepared by the levitation melting technique.

The results of the heat capacity measurements on Ta_2H revealed three large anomalies--at about 305, 332 and 333°K, the latter two forming a double peaked anomaly. This suggests that Ta_2H exists in four forms, β_1 below 305°K, β_2 between 305 and 332°K, β_3 between 332 and 333°K and α above 334°K.

The anomalies at 305, 332 and 333°K were considered to be due to transitions of β_1 to β_2, β_2 to β_3 and β_3 to α-Ta_2H, respectively. The entropies (in e.u. per gram atom of hydrogen) associated with these transitions are 0.70 for β_1 - β_2, 2.60 for β_2 - β_3 and 1.60 for β_3 - α. The existence of the β_1, β_2 and α forms had earlier been indicated by neutron diffraction patterns, although the exact structures had not been determined. The residual entropy of Ta_2H was found to be -0.39 ± 0.30 e.u. per gram atom of hydrogen. Thus, Ta_2H is regarded as obeying the Third Law of Thermodynamics. The configurational entropies (in e.u. per gram atom of hydrogen) for the various forms of Ta_2H were calculated to be 0.70 for β_2-Ta_2H, 3.30 for β_3-Ta_2H and 4.90 for α-Ta_2H. Discussions are given on the relationship of these values to the various structures involved.

The heat capacity curve of $DyCo_5$ showed a small thermal anomaly having an unusual profile at about the same temperature as that of its magnetic anomaly at 360°K. The excess heat capacity is smaller than usual for magnetic rearrangements suggesting that the magnetic transformation involves only a slight alteration in the coupling of the magnetic moments. There is some indication that there is an appreciable magnetic contribution to the heat capacity at all temperatures up to 360°K. Thus the anomaly at this temperature may be the culmination of an alteration which has been occurring gradually at all temperatures below 360°K. $DyCo_5$ has an additional magnetic anomaly at about 125°K. This does not show up directly as a hump in the heat capacity curve.

To date, no data on the absolute entropy of formation of $DyCo_5$ are available, hence the determination of the residual entropy cannot be made at this time.

Microfilm $2.75; Xerox $4.60. 90 pages.

THE CRYSTAL STRUCTURES OF SOME PALLADIUM AMALGAMS AND OF THE MINERAL POTARITE

(Order No. Mic 61-391)

Kazuji Terada, Ph.D.
University of Utah, 1961

Chairman: F. William Cagle, Jr.

The crystal systems of the palladium-mercury binary alloys were studied by the Debye-Scherrer X-ray diffraction method. Part of the work involved placing potarite, a mineral composed of these two elements, in the proper position within the binary system. The mineral was reported to belong to the isometric crystal system, but it has been shown in this work to belong to the tetragonal system. The mineral has also been synthesized in two different ways. One method consisted of heating the two components, liquid mercury and powdered palladium, in thick-walled pyrex capillaries at about 400°C for several days. The other method was a replacement reaction between a palladous perchlorate solution and excess liquid mercury.

In the composition range of the binary alloys, from pure mercury to pure palladium, the tetragonal phase was between the solid solution of mercury in palladium on the high palladium side and at least two very complex phases on the high mercury side. Trial structure intensity calculations for a body-centered tetragonal structure showed good agreement with the observed lines. The two complex phases on the high mercury side were very rich in lines and could not be indexed. The various conventional methods for indexing powder patterns were tried, including Ito's method, but were not successful.

Four types of computer programs were written for the Burroughs Datatron 205 digital computer in order to eliminate some of the time consuming calculations associated with crystal structure work. The programs are, (1) calculation of interplanar distances "d"s with absorption corrections, (2) calculation of "d"s and "Q"s ($1/d^2$) from the crystal parameters, (3) Ito's method to index powder patterns regardless of symmetry and (4) calculation of the "best set" of parameters on the basis of observed "Q"s for the isometric, tetragonal, orthorhombic, and monoclinic systems.

Microfilm $2.75; Xerox $6.40. 135 pages.

STUDIES IN CHRONOPOTENTIOMETRY

(Order No. Mic 61-1418)

Anthony C. Testa, Ph.D.
Columbia University, 1961

1. A discussion is given of chronopotentiometric procedures in which the current density is changed in a step-functional fashion during the electrolysis. Cases corresponding to increase, decrease, cessation, and reversal of current are considered with a view to their application to analysis and the study of electrode processes. Theoretical equations and their experimental verifications are given for single and multi-component systems.

2. The hydrolysis of p-quinoneimine was studied by generating the species electrochemically at constant current, then following its hydrolysis chronopotentiometrically by reversing the current. The data were consistent with theory on the assumption of an irreversible reaction first order in p-quinoneimine. Pseudo-first order rate constants for the hydrolysis are: 0.140, 0.103, 0.032 $sec.^{-1}$ in 0.05 M, 0.1 M, 0.5 M H_2SO_4 respectively.

3. A method for calculation of rate constants of irreversible chemical reactions following reversible electrochemical reactions from chronopotentiometric potential-time curves is presented, and applied to the oxidation of p-aminophenol. Advantages of this method over one previously proposed by Snead and Remick are discussed. Semi-quantitative calculations are given of the effect of variation of actual rate constants with distance from the electrode on apparent rate constants deduced with this experimental technique. The effect is concluded to be negligible except when the thickness of the reaction layer and double layer are comparable in magnitude.

4. The electrochemical reduction of o-nitrophenol was studied chronopotentiometrically in a buffered ethanol-water mixture. Results obtained were consistent with the scheme: $A \xrightarrow{4e} B \xrightarrow{k} C \xrightarrow{2e} D$. Comparison of data with a theoretical equation allowed the determination of the formal pseudo-first order rate constant for the intermediate chemical reaction.

5. A theoretical discussion is given of the chronopotentiometric behavior of systems in which the reaction mechanism consists of three successive first order steps, each of which may be chemical or charge transfer. In many cases the theory reduces to that for simpler two or one step mechanisms. Rigorous equations are given for some cases in which this is not so. Methods for distinguishing between possible mechanisms are discussed with emphasis on the difficulty of assigning unambiguously the location of slow chemical steps.

6. Chronopotentiograms were recorded for the reduction of nitrobenzene in acetate buffer at an apparent pH 6.2 in 50% ethanol-water mixture. The absence of a kinetic complication at high currents and short transition times is presented as evidence supporting the hypothesis that the first step in the reduction of nitrobenzene is a reversible one electron transfer, i.e. $\text{Ø}NO_2 + e \rightleftharpoons \text{Ø}NO_2^-$.

Microfilm $2.75; Xerox $5.20. 104 pages.

MECHANISM OF BRIGHT ELECTROPLATING: LAMINATIONS AND PERIODICITY IN THE DEPOSITION OF NICKEL AND COPPER.

(Order No. Mic 61-2344)

Nicholas Vanderkooi, Jr., Ph.D.
Wayne State University, 1958

Adviser: Dan Trivich

A study was made of the laminated structure of nickel electrodeposits produced in plating baths with a Watts type base and containing various organic brighteners. A detailed investigation of the effect of brightener concentration and current density on lamination thickness was made using the brightener system sodium allyl sulfonate and N-allyl quinaldinium bromide. The lamination thickness was found to be constant at 0.5 microns over a wide range of brightener concentration and current density. However, the lamination thickness was found to depend on the microscopic shape of the electrode surface. Copper deposited from an acid copper bath containing thiourea also has laminations 0.5 microns thick.

The results of this thesis are in accord with recent generally accepted theories of leveling based on preferential supply of inhibitor to the peaks with relatively enhanced plating of metal in recesses. In this thesis the details of the process are explained in terms of lamination formation. The mechanism postulates that the peaks are inhibited first and must wait until the adjacent recesses also acquire an effectively complete coverage by inhibitor at which time a new wave of crystal growth begins on a new set of nuclei over that section of the electrode.

Periodic fluctuations in the current during nickel plating were measured with a chart recorder. Vibrations, convection and non-synchronous action of the surface gives many random fluctuations which make interpretation difficult. The most pronounced current fluctuations were obtained with a bath that gave the best defined laminations. However, the observed frequency of the current fluctuations did not agree with the observed frequency of formation of laminations.

Microfilm $2.75; Xerox $7.80. 168 pages.

DIELECTRIC RELAXATION AT HIGH FREQUENCIES

(Order No. Mic 61-2006)

Worth Edward Vaughan, Ph.D.
Princeton University, 1960

An apparatus for the determination of dielectric constants and losses of polar liquids at 4.3 mm. wave length by an interferometric method is described. The ratio to the incident power of the power reflected from the air-dielectric interface (of a dielectric sheet backed by a metal plate) is determined as a function of the dielectric sheet thickness. From total reflection for the metal plate alone, one observes a series of damped maxima and minima asymptotically approaching a constant value for the infinitely thick layer. The dielectric constant is related to

the apparent wave length in the dielectric as determined from the spacing between successive extrema of the ratio of reflected to incident power. The dielectric loss is related to the rate at which the maxima attenuate with increasing sheet thickness.

Equations relating the experimental observables to the dielectric constant and loss are derived from Maxwell's equations using Snell's and Fresnel's Laws at the various interfaces between unlike media.

Dielectric constants and losses at 4.3 mm. wave length have been measured for diphenyl ether, benzophenone, chlorobenzene, trifluorobromomethane, anisole, o-, m-, and p-dimethoxybenzene at various temperatures between 20 and 80°C. The results have been interpreted in terms of existing lower frequency data. Chlorobenzene and trifluorobromomethane show one Debye-type dispersion region as expected. Diphenyl ether and benzophenone have two relaxation times, one corresponding to over-all molecular rotation and the other to internal rotation accompanied by a mesomeric shift of charge. The methoxybenzenes have two relaxation times, one corresponding to over-all molecular rotation and the other to methoxy group rotation.

The relaxation times of dilute solutions of camphor, fluorobenzene and t-amyl alcohol in carbon tetrachloride have been determined from measurements of dielectric constants and losses at 1.25, 3.22, 10.0, 25.0, and 50.0 cm. wave lengths at 20, 40, 60°C. The relaxation times are discussed in terms of factors used to approximate the internal friction factor in the Debye equation. It appears that neither the solvent viscosity nor a mutual viscosity defined by Hill provide a very satisfactory approximation to this factor. Mutual viscosities have been calculated from viscosity and density data for seven rigid, approximately spherical, polar solutes in carbon tetrachloride solution. Using the mutual viscosity in place of the solvent viscosity seems to offer no advantage for these compounds.

The intensity of the fundamental OH stretching vibration was investigated by infra-red spectroscopy for various alcohols in carbon tetrachloride solution as a function of concentration. Equilibrium constants for dimer formation were calculated and used to determine the percentage of monomer present in the alcohol solutions. Thus solution concentrations for dielectric measurements could be chosen such that essentially all the alcohol was present as monomer. Microfilm $2.75; Xerox $4.60. 89 pages.

ON THE DIMENSIONS OF LINEAR POLYMERS

(Order No. Mic 61-2073)

Carl Alexander von Frankenberg, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Robert E. Hughes

PART I: ON THE EXCLUDED VOLUME EFFECT

The methods used by James[1] and Fixman[2] to calculate $\langle r^2 \rangle$, the mean square end-to-end extension of a linear polymer, in three dimensions are generalized to an arbitrary number of dimensions. This generalization has a two-fold object, first, to provide a more extensive comparison of the two procedures and, second, to compare the results obtained with those arrived at by other authors from different considerations.

To first order in v, the volume excluded by one bead (chain element) to the center of another, one finds from James' procedure that $\langle r_q^2 \rangle = t\ell^2 \left[1 + C_q v t^{2-q/2}\right]$ where t is the number of links in the chain, ℓ is the bond length, q is the dimensionality of the space, and C_q is a constant.

From Fixman's procedure one finds:

$$\langle r_2^2 \rangle = t\ell^2 \left[1 + \frac{v}{2\pi}\frac{t}{\ell^3}\right] \text{ for } t^{\frac{1}{2}} \gg 1$$

$$\langle r_3^2 \rangle = t\ell^2 \left[1 + \frac{4}{3}\left(\frac{3}{2\pi}\right)^{3/2}\frac{vt^{\frac{1}{2}}}{\ell^3}\right] \text{ for } t^{\frac{1}{2}} \gg 1$$

$$\langle r_4^2 \rangle = t\ell^2 \left[1 + \left(\frac{2}{\pi}\right)^2\left(\frac{3}{2\pi}\right)^{\frac{1}{2}}\frac{v \ln t}{\ell^3}\right] \text{ for } \ln t \gg 1$$

$$\langle r_5^2 \rangle = t\ell^2 \left[1 + \frac{4}{\pi}\left(\frac{5}{2\pi}\right)^{5/2}\frac{v}{\ell^3}\right] \text{ for } t^{\frac{1}{2}} \gg 1$$

$$\langle r_q^2 \rangle = t\ell^2 \left\{1 + v\left[0\left(t^{-a}\right)\right]\right\} \text{ for } q \geq 6,\ a > 0,\ t^{\frac{1}{2}} \gg 1$$

where we have included Fixman's three dimensional result.

An attempt is also made to calculate $\langle r_3^2 \rangle$ to second order in v from an extension of James' procedure for comparison with Fixman's second order perturbation. Unfortunately, the modified distribution function for chain extensions obtained appears to make the calculation of $\langle r_3^2 \rangle$ to second order intractable except by machine methods.

The models used in the previous analyses permit any member of a polymer chain to overlap any other. Also, the actual polymer chain of t links is replaced by a random chain of t links. To improve the model, one may replace the actual chain by an equivalent random chain so proportioned that $\langle r^2 \rangle$ and $r_{max.}$ of the two are the same. One then stipulates that only the joints of the equivalent chain may overlap. In the analysis, taking cognizance of the presence of beads intermediate to the joints, one is led to a modified Fokker-Planck equation of the James type. Solving this equation leads one to a distribution function for chain extensions from which one obtains $\langle r_3^2 \rangle \equiv Kt\ell^2 \left[1 + \frac{4}{3\pi^{\frac{1}{2}}}\left(\frac{27}{8\pi^2}\right)^{\frac{1}{2}}\frac{vt^{\frac{1}{2}}}{\ell^3 K^{5/2}}\right]$ where K is a constant depending on the geometry of the actual chain.

The discussion of the volume effect is concluded with the formulation of an improved distribution function for chain extensions:

$$f(r)dr = \frac{4}{\pi^{\frac{1}{2}}}\frac{\Gamma\left[\frac{3t+3}{2}+1\right]}{\Gamma\left[\frac{3t+2}{2}\right]}\frac{r^2\left[1-\left(\frac{r}{t\ell}\right)^2\right]^{3/2}dr}{(t\ell)^3}.$$

The properties of this function are intermediate between the usual Gaussian and the exact expression involving an inverse Langevin function. The improved function is used in calculations for which the Gaussian has previously been used and the results are compared with those obtained using the Gaussian.

PART II: ON CHAIN DIMENSIONS UNPERTURBED BY VOLUME EXCLUSION EFFECTS

In the first section of this part an expression is obtained for $\langle s^2 \rangle$, the mean square radius of gyration, of

a linear polymer made up of r arbitrarily located stiff (colinear) bond sequences.

The remaining sections of this part are primarily concerned with applications of Eyring's rotation matrices. An expression is found for $\langle r^2 \rangle$, for a polymer assumed to have four different bond lengths and four different coordinate system transformations, which may readily be specialized to numerous special cases including cases not previously considered. The Eyring matrices are further used to calculate $\langle r^2 \rangle$ for a block copolymer, the mean square lateral extension of a linear polymer, and to describe a "three-atom" polymer structure on a helical point net.

1. James, H. M. J. Chem. Phys. 21, 1628 (1953).
2. Fixman, M. J. Chem. Phys. 23, 1656 (1955).

Microfilm $2.75; Xerox $6.00. 121 pages.

UNIMOLECULAR REACTION RATE THEORY AND APPLICATIONS

(Order No. Mic 61-1270)

Grace Marilyn Wieder, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Rudolph A. Marcus

The unimolecular reaction rate theory of Marcus and Rice was applied to existing unimolecular rate data. This theory has the advantages of (1) the absence of the curve-fitting parameter appearing in the generally applied HKRR formulation, (2) applicability under conditions where the activation entropy is relatively large, and (3) comparative simplicity of utility in either a quantum-mechanical or classical form.

Quasi-unimolecular rate constants as a function of pressure p were computed for (a) cyclopropane → propylene, (b) cyclobutane → ethylene, (c) methylcyclopropane → butene-1 + butene-2 isomers, (d) $N_2O \rightarrow N_2 + O$, (e) cis butene-2 → trans butene-2, (f) $C_2H_5Cl \rightarrow HCl$ + ethylene, and (g) $N_2O_5 \rightarrow NO_2 + NO_3$. In (a) – (f) "rigid" activated complexes, which have the same number of rotations as the reactant, were postulated. The vibrational frequencies of the complex were assigned so as to obtain agreement between the theoretical and experimental factors at $p = \infty$. In (g) a "loose" complex containing freely rotating NO_2 and NO_3 groups was employed.

The classical limit of the Marcus-Rice expression was used to estimate the classical error for some of these reactions by computing rate constants at various pressures for (a), (d) and (g) and comparing with the quantum results.

Limiting second-order rate constants were calculated from the limits of $p \rightarrow 0$ of both the quantum and classical expressions, for (a), (d), (g), and (h) $O_3 \rightarrow O_2 + O$, (i) $F_2O \rightarrow OF + F$, (j) $NO_2Cl \rightarrow NO_2 + Cl$, (k) $H_2O_2 \rightarrow 2OH$, (l) $N_2O_4 \rightarrow 2NO_2$, and (m) $C_2H_6 \rightarrow 2CH_3$. At the low pressure limit the quasi-unimolecular rate approaches that of the bimolecular rate of energization and is independent of the activated complex.

Log-log plots of the reduced rate constant k/k_∞ vs. p, computed from the quantum formulation showed that, except for (d) and (e), the theoretical pressure $p_{\frac{1}{2}}$ at which the rate constant becomes one-half its high pressure value was in reasonable agreement with experiment (typically within a factor of about 4). In each instance, the calculated $p_{\frac{1}{2}}$ was too low, a result expected upon consideration of inherent equilibrium assumptions. Separate calculations for reaction (a) based on alternate reaction coordinates, involving either a C-C break or H migration with ring deformation, respectively, showed essentially the same pressure dependence for $\log k/k_\infty$. This result, which was also obtained when alternate activated complex models were employed in (d), indicates the relative insensitivity of the Marcus-Rice theory to the choice of reaction coordinate, provided that the latter is reasonable and that the entropy requirements corresponding to the experimental high-pressure frequency factor are satisfied.

Results on the effect of temperature on $\log k/k_\infty$, obtained by quantum computations at two different temperatures each for (a) and (c), showed, in accordance with experiment, a shift of the $\log k/k_\infty$ vs. $\log p$ curves towards higher pressures when the reaction temperature is raised. The magnitude of this shift for (a) was only about one-half the observed value of 0.53 units. However, the latter experimental value is not based on work done in one laboratory and may therefore be suspect. The amount of the shift for (c) was in excellent agreement with the 0.3_0 units observed by Chesick. A simple approximate expression is given as a means of predicting the magnitude of the shift for these two reactions over a small temperature range.

The second-order rate constants computed from the quantum form of the theory were in moderate agreement with experiment (typically within a factor of about 5 except for (d) and (j)).

The computed values of $p_{\frac{1}{2}}(q)/p_{\frac{1}{2}}(c)$, where c and q refer to the classical and quantum forms of the theory, respectively, were for (a) 20, (d) 2, and (g) 59, reflecting the error in the classical theory. The classical-quantum ratio of second-order rate constants generally increased with molecular complexity and became large.

The quantum results support the assumption that all vibrations of the energized molecule readily contribute energy to the breaking bond. Although a classical model may be a fair approximation for small molecules, a quantum treatment should be employed for complex reactants, especially at low temperatures.

Microfilm $2.75; Xerox $6.00. 122 pages.

A VARIABLE FREQUENCY SPECTROPHONE STUDY OF CARBON MONOXIDE

(Order No. Mic 61-2423)

Wayne Earl Woodmansee, Ph.D.
Oregon State College, 1961

Major Professor: John C. Decius

Prior to this research, the spectrophone has been used to measure vibrational-translational relaxation times in CO_2, N_2O, and CO. In the earlier studies carried out by this technique, relaxation times were measured by determining the phase lag between the spectrophone signal and a reference signal related to the intensity of the modulated radiation entering the spectrophone cell. On the assumption that apparatus phase shifts were constant during a series of measurements on gases at different pressures or with gas mixtures of different composition, a constant "apparatus phase shift" was found and subtracted from each of the experimentally measured phase shifts. The difference between the experimental and apparatus phase shifts was then related to the relaxation time for the gas.

A discussion of the relaxation behavior of a gas in the spectrophone cell is given which indicates that measurement of the frequency response of the spectrophone signal should afford a new method for determination of relaxation times. The spectrophone response is obtained as a function of the light chopping frequency, the relaxation time, the heat capacity of the gas, and the Einstein coefficient of spontaneous emission of radiation. When the product of the angular chopping frequency and the relaxation time is large with respect to unity, a loss of spectrophone signal is predicted by the expression for the signal response. A gas with a millisecond relaxation time, therefore, will exhibit signal loss at much lower chopping frequencies than a gas with a microsecond relaxation time.

A variable frequency spectrophone developed to compare the signal response of "slow" ($\tau \cong 10^{-3}$ sec) and "fast" ($\tau \cong 10^{-6}$ sec) relaxing gases is described. With this apparatus, spectrophone signals could be selectively measured at chopping frequencies between 20 cps and 2,000 cps. A description is also given of an apparatus used to compare the relative phase of the spectrophone signal and a reference signal generated by the light chopper.

Experimentally, signal response studies were made with carbon monoxide, carbon dioxide, methane, ethane, hydrogen chloride, ammonia, propane, n-butane, and isobutane. These response curves indicated the presence of acoustic resonance phenomena which complicated the comparison of "slow" and "fast" relaxing gases. Measurement of the phase relation between a reference photo-multiplier signal and the signal from the spectrophone cell containing ethane showed that a 180° phase change occurred between the low and high frequency sides of the resonance. As the frequency at which resonance occurred was dependent on both gas pressure and composition, it appeared that the assumption of a constant "apparatus phase shift" would not be correct and phase measurements could not yield a correct value for the relaxation time.

To determine the effect of pressure on the relaxation time of carbon monoxide, signal response studies were carried out at pressures ranging from .5 to 4 atmospheres. In order to estimate the relaxation time for carbon monoxide, the response curves obtained with CO were compared with similar curves for carbon dioxide ($\tau \cong 10^{-6}$). By this procedure, the relaxation time for CO at one atmosphere was estimated to be 2 milliseconds. Response studies of CO mixed with H_2 demonstrated that the mixtures relaxed more rapidly than pure CO.

Microfilm $2.75; Xerox $5.80. 116 pages.

ECONOMICS, GENERAL

INDUSTRIAL AGGLOMERATION THEORY AND THE AGGLOMERATIVE IMPACT OF BASIC STEEL MILLS – TWO CASE STUDIES.

(Order No. Mic 60-4971)

Benjamin B. Christopher, Ph.D.
Princeton University, 1960

The subject of this study arose from the problem of estimating the agglomerative effects of U. S. Steel Corporation's Fairless Works, which was established in Bucks County, Pennsylvania, in 1952. In line with customary thought that steel mills are an "agglomeration-inducing" type of activity, considerable discussion arose concerning the effect of the mill in inducing growth of other industry and employment in the Trenton-Lower Bucks County area. It is evident that the mill might tend to stimulate directly such growth in the suppliers of goods and services to basic steel, as well as users of its end-products, and indirectly in industries related in these ways to this second group.

In regard to the problem of analyzing the growth of steel-using industries in the area, it was found that various techniques have been used by other writers interested in the general problem, and in other steel areas. These methods include correlation technique, certain statistical association-relationships, and ratios of steel-using activity to basic steel activity for the entire nation or for a group of sample steel centers. Each of these methods, however, is subject to definite limitations and leaves much to be desired. Some fundamental questions arise, such as: How much total steel-using activity should be expected to be induced in an area surrounding newly established basic steel facilities? What types of steel-using industries tend to be the most subject to these influences? In those industries, which are affected, what factors are present which give rise to the agglomerating effects? It is apparent that similar questions may also be applied in the case of large scale manufacturing facilities in other basic industries, as well as the steel industry. Thus in concluding the analysis, comments are made in regard to generalizing some of the findings toward application to these other industries.

The approach of the study is developed along three main lines. First, there is the theory of agglomeration, which is presented in the first two chapters. These chapters define the concept and outline the various conditions which might give rise to agglomerations of other industry at basic steel centers and elsewhere.

The next portion of the analysis is concerned, first, with the selection of specific steel-using industries for further study, and in describing some of their major characteristics. Second, by an analysis of actual location patterns, we are enabled to determine which individual industries show the greatest degree of spatial association with basic steel capacity. The material enables a test to be made of certain hypotheses, for example, that it is "heavy" steel-using industries which are primarily attracted toward the source of raw steel. The locational patterns are often revealing also of the specific locational determinants, in addition to proximity to the steel supply, which prevail in the various industries.

The final two chapters constitute the results of intensive studies of two "new" basic steel areas, that is, areas in which extensive integrated steel capacity has been installed fairly recently, and which heretofore had no (or very little) such capacity. These areas were Trenton, New Jersey – Lower Bucks County, Pennsylvania, and Salt Lake City – Provo, Utah. Interviews were conducted with approximately 80 steel-using firms, and numerous other industry persons, in these areas. An intensive analysis was made of steel-using activity in these areas through the interviews, including recent growth of total employment in the industries as a group, the specific industries involved, and the factors which have led to the entry of new plants, or affected the scale of existing ones. Conclusions are drawn concerning the part actually played by the newly-established basic steel capacity in the development of steel-using activity in the two areas.

The final summary chapter contains two parts, first, a resume of the main findings of the study, and second, a commentary and critique on methodology and tools of analysis. In general the results do not support the thesis that a newly-established integrated steel mill inevitably gives rise to an extensive agglomeration of steel-using activity. In neither of the present study areas does the volume of directly-induced steel-using activity come near to approximating the scale (in employment) of the basic steel operation. Moreover, both the locational pattern analysis and interview results indicated that the industries more strongly attracted spatially by steel are the heavy fabricators, and since these are relatively low value-added, high tonnage industries, they are in themselves low in agglomeration-inducing qualities. As this fact suggests, the Weberian theoretical framework, with emphasis upon minimization of transport costs, provides a useful guide for analysis of this type of agglomeration. While the Weberian theory of "external economies" and agglomeration is closely applicable to the steel-using industries generally, it is of minimal value in explaining the formations of such agglomerations at steel centers. The various "revenue-maximizing" theories, such as Loesch's theory, and the Interdependence framework (e.g. Hotelling's system) are also severely limited by restrictive assumptions in their application to the type of agglomerations of primary concern in this study.

Microfilm $6.05; Xerox $21.40. 475 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

WAGE AND NON-WAGE SHARES IN BUSINESS PRODUCT, 1899-1929.

(Order No. Mic 61-2036)

Arthur Ira Grant, Ph.D.
University of Pennsylvania, 1961

Supervisor: Professor Sidney Weintraub

The purposes of this study are threefold: (1) to establish consistent annual estimates, for the years 1899-1929, of the gross product of business enterprises organized for the pursuit of profit, and to do the same for the two major income shares, profits and employee compensation, which have been generated by the private business sector of the economy; (2) to examine the temporal behavior of these estimates, and to relate that behavior to the outstanding industrial changes which have occurred during the period; (3) to explore the relations among annual changes in the price level, average product, and the rate of employee compensation.

Secondary sources were utilized almost exclusively, and major problems surrounded reconciliations of reported data. In general, these problems were solved on the basis of (1) the reasons for differences among the source estimates, and (2) the assumption that these estimates contain accurate annual percentage changes. Certain conceptual difficulties also had to be overcome, particularly with regard to the net income payments engendered by the business community. These involved the operational definition of profits, and the treatment of business taxes, depletion and capital consumption allowances, business transfers, and subsidies. The proposed solutions are believed to be consistent with each other, and yet sufficiently practical to render the final estimates operationally meaningful.

All current dollar aggregates grew more rapidly between 1909 and 1919 than during either of the two surrounding decades. Gross business product in 1929 dollars, on the other hand, grew at a declining rate throughout the period, and apparently continued to do so after 1929. All aggregates also exhibited perfect conformity to the eight complete reference cycles which occurred during the period. Gross product and employee compensation followed almost identical paths throughout the period, while profits behaved much more dramatically.

Except for the years occupied by World War I and its immediate aftermath, the profits share in gross product declined fairly steadily throughout the period. The corporate profits component increased slightly, however, and the decline was thus concentrated in the entrepreneurial sector. In general, the profits share rose and fell faster than the wage share, and in the years of resistance to wage changes, the two shares most often moved in opposite directions.

Again, except for the war years, the wage share constituted an almost constant 48 percent of gross business product. The constancy of the inverse of this relationship, which has been designated "k," implies that the price level varied with employee costs per unit of output, or alternatively: directly with the rate of employee compensation, and inversely with average product per employee. Empirical testing of these implications revealed their substantial truth.

The stability of k introduces the possibility of explaining changes in the general price level by changes in the ratio of employee costs per unit of output, or alternatively, by changes in the ratio of the wage rate to average product. Professor Sidney Weintraub, in his recent A General Theory of the Price Level, Output, Income Distribution and Economic Growth, found a similar stability for the years 1929-1957. Thus, if a constant wage share is taken as a datum of the economic system, then either output, prices, or both, must change along with changes in the rate of employee compensation. In consequence, new directions are implied for the control of the price level, and important theoretical issues are raised by the seeming inevitability of these relationships.

Microfilm $4.30; Xerox $15.10. 333 pages.

MAJOR ECONOMIC CHANGES IN THE MINING AND DISTRIBUTION OF PENNSYLVANIA BITUMINOUS COAL

(Order No. Mic 61-2372)

John Nathan Hoffman, Ph.D.
The Pennsylvania State University, 1961

This study analyzes certain paramount factors in the shift of markets for Pennsylvania bituminous coal with particular emphasis on the changes in the pattern of distribution. The situation in Pennsylvania has regional peculiarities as well as reflecting the economic status of the bituminous coal industry in the nation as a whole. By confining this study to Pennsylvania a more detailed study was made of the economic problems, changes in the distribution patterns, and the shifting of markets than would be possible if the national bituminous coal industry were studied in its entirety.

The economic analysis of Pennsylvania's bituminous coal industry follows the sequence: Reserves; Production; Channels of Distribution; Destination of Shipments; Market Structure; and Pricing Problems. Statistical data concerning the Pennsylvania bituminous coal industry were for the fifty-year period, 1909 to 1958. When necessary, data pertaining to the coal industry on a nationwide scope were used and national trends were determined and compared with Pennsylvania's bituminous coal industry.

The regional shifts and instability of the Pennsylvania bituminous coal industry were found to be caused by the nature of the coal industry itself and in circumstances peculiar to the industry, i.e., the channels through which the coal industry must reach its markets vast market to which the flow of coal was directed. Though individual problems and weaknesses can be identified, they were so interrelated and overlapping that a simple description or explanation was often impossible.

Two major factors that play a basic part in the coal industry's instability were: (1) huge resources of bituminous coal scattered over wide areas which allow the opening of many new mines; and (2) the large over-capacity of existing mines under an ownership that is so largely decentralized that control of the output is practically an impossibility.

The coal industry normally over-expanded and always threatened with further expansion has always depended

upon markets which are continually varying because of changes in demand by coal-consuming industries and the importance of competitive fuels. Between over-expanded coal producers and a market characterized by continual change, there were transportation agencies engaged in rivalry for traffic. The major carriers in Pennsylvania, of course, were the railroad and barge companies, although the trucking industry has shown a significant increase in importance as a coal carrier in Pennsylvania in the past twenty-five years.

While transportation agencies vie with each other for coal traffic, both coal operators and consumers, particularly large consumers, actively favor transportation rate changes that look favorably to them and actively fight those that look unfavorably. Consequently, operators can feel reasonably assured that they will hold the markets they already have and will gain new markets only by offering attractive prices at the mines. Operators must deal strenuously with operating costs to offer advantageous mine prices, and this was most frequently achieved by increasing mechanization, operating in more easily accessible coal seams, and by keeping wage rates down.

The bituminous coal industry in Pennsylvania has remained highly competitive. Not only is competition keen among the various producers of bituminous coal, but bituminous coal must compete in the fuel market with other sources of heat and energy. However, the discussion in this thesis was concerned with the internal competitive behavior of the Pennsylvania bituminous coal industry and did not attempt to analyze inter-fuel competition which has been the subject of many other studies. However, it still must be recognized that the bituminous coal industry has been subjected to these external conditions. Due to this combination of internal and external competition the industry has experienced many and rapid changes, particularly shifts in demand from one producing district to another because of the differences in costs or of the quality of the coal.

Microfilm $4.00; Xerox $14.20. 311 pages.

COMPETITION BETWEEN COMMERCIAL BANKS AND A PRODUCTION CREDIT ASSOCIATION: A CASE STUDY.

(Order No. Mic 61-1973)

Kenneth Denton Patterson, Ph.D.
The University of Nebraska, 1961

Advisers: A. Stuart Hall
Campbell R. McConnell

Since early in the 20th century agricultural financing has undergone sweeping changes. An almost continual farm depression following World War I stimulated federal government activity in farm credit markets. A nationwide network of credit cooperatives (production credit associations) was established as an outlet for funds drawn from national money markets. These associations provide operating credits similar to commercial bank credit. This study analyzes the nature of market competition between private banks and a cooperative production credit association providing a similar product in a six county area. A major purpose of this study is to compare the actual functions and capabilities of the production credit system with its legislative background.

The Lincoln, Nebraska Production Credit Association operates in a territory served by approximately forty commercial banks. Market competition consists of two elements: Organization and behavior. Organization involves product characteristics, internal financial and operating structure, and sources of funds. Behavior refers to market activity taken by a firm toward its rivals, customers, and potential customers. The market behavior of the Lincoln Association was not aggressive in seeking new membership and emphasizing organizational advantages. The dependence of the Association on the Federal Intermediate Credit Bank of Omaha for operating policy as well as for loan funds may account for nonaggressive market behavior, rigid loan techniques, and reluctance to encourage membership growth. Once a certain membership level is achieved satisfaction to members in terms of net credit cost may conflict with increased membership. Stock purchase requirements for members are low relative to capital surplus requirements, resulting in assignment of earnings to reserves rather than to dividends. This tendency to undercapitalization discourages membership expansion. The Lincoln Association reflected a classical rationale rather than a cooperative rationale: emphasis was given to maximizing satisfaction of present members rather than to extending benefits to more farmers.

The loans of the Association were larger, better secured, contained less potential risk, and carried a slightly higher interest rate than loans offered by commercial banks in the area.

The flow of private funds provided by intermediate credit bank debentures seemed capable of supplying a volume of funds greater than was required by the Association between 1948 and 1956. Costs of funds to the Association and to its members were closely connected with movements in private money markets. During this period commercial banks exhibited the potential to expand their farm loan volume.

Banks also exhibited nonaggressive market behavior toward the Association and borrowers. Bankers generally were inaccurately informed concerning Association loan features and insisted that the Association did not influence bank lending. Most bankers opposed the existence of the Association apparently for rather emotional reasons. Neither the Association nor the intermediate credit bank felt it proper to engage in price and term competition with commercial banks.

The most appropriate function of the production credit system is the provision of intermediate capital credits. Alternative functions are limited due to credit requirements caused by reliance on private funds and by the improbability of uniform market activity among the units of the system. Possible reluctance of a member controlled credit system to support publicly desirable credit activities suggests that expansion of cooperative ownership and control may be detrimental to the effectiveness of the system as an instrument of public policy, unless that policy is simply to encourage cooperative organization.

Microfilm $4.00; Xerox $13.95. 309 pages.

ECONOMICS, AGRICULTURAL

EFFECTS OF PACKAGING ON RETAIL EGG SALES AND ON QUALITY DETERIORATION

(Order No. Mic 61-2116)

Robert Paul Bentz, Ph.D.
Louisiana State University, 1961

Supervisor: Ewell P. Roy

The general purpose of the study was to determine the effect on egg sales and egg quality of several types of cartons and egg treatments. The problems under consideration were the decline in per capita consumption of eggs and loss in quality as eggs pass through the marketing channel.

A five week sales response test was conducted in five supermarkets in Shreveport, Louisiana, in the Spring of 1960. Five dual displays were rotated among these stores according to a latin square design, and differences in sales among displays were analyzed by the technique of analysis of variance. Differences in sales between the two parts of each display were analyzed by the use of chi-square analysis.

The test of quality deterioration measured differences in quality retaining characteristics of a cellophane wrap and mineral oil spray relative to untreated eggs packed in standard cartons. This test measured internal quality decline in a total of 864 eggs broken-out at weekly intervals over a three week period. The eggs were held under two temperature conditions, approximately 45 and 73 degrees Fahrenheit.

The sales response test showed that consumers preferred cellophane wrapped cartons over similar cartons without cellophane. Fifty-five percent of sales of this matched display were in cellophane wrapped cartons.

A strong preference was shown for the standard carton or the same carton overwrapped when they were matched in dual displays with a clear plastic container having an added mark-up. Sales of the plastic carton accounted for only 11 to 12 percent of total sales when the premium on the plastic carton was seven and four cents respectively per dozen. Reaction to price and preference for carton type, however, were inseparable.

The dual display in use prior to the experiment had the lowest average volume of sales, 859.8 dozens per week or 10.6 dozens per one hundred customers. A statistical analysis indicated that any or all of the other four dual displays resulted in increased sales over this display. The combination of cellophane wrapped cartons and plastic containers with a seven cent added mark-up resulted in the greatest volume of sales, an average of 1,018.2 dozens or 13.2 dozens per one hundred customers.

The over-all quality deterioration study indicated that temperature under which eggs were held was the most important factor tested in determining quality deterioration. Average quality of refrigerated eggs was 74.4 compared to 55.4 Haugh units for those at room temperature.

Analysis of eggs kept at room temperature, however, showed that these eggs declined in quality significantly over time. In addition, the eggs sprayed with mineral oil were significantly higher in quality than those left untreated, 64.4 compared to 47.6 Haugh units. Eggs overwrapped with cellophane were not significantly different in quality than the untreated eggs, 47.6 compared to 54.4 Haugh units.

It is concluded, therefore, that the use of cellophane is not justified on the basis of its quality retaining characteristics. Mineral oil spray is the more effective of the two methods in upholding quality of eggs kept at room temperature. Nevertheless, cellophane overwrapping can be justified on the basis of consumer preference and its tendency to increase egg sales.

Microfilm $2.75; Xerox $7.80. 166 pages.

CONSUMERS' PREFERENCES FOR SELECTED TYPES OF FOOD PACKAGING

(Order No. Mic 61-2358)

Thomas Marion Brooks, Ph.D.
The Pennsylvania State University, 1961

The over-all objective of this study was to obtain information which may lead to increased consumer satisfaction from the packaging of farm food products.

Specifically, the objectives of this study were to: (1) Obtain consumers' preferences for selected types of food packaging. (2) Investigate the nature of the criteria used by consumers in the selection of particular food packages. (3) Investigate relationships between consumers' reasons for package preferences and the social and economic characteristics of the consumers.

The data for this study were obtained by direct-interview of 755 homemakers in the metropolitan area of Harrisburg, Pennsylvania during the summer of 1957. The sampling of homemakers was stratified in order that the differences in packaging preferences and the reasons for these preferences could be determined for homemakers residing in old and new housing areas, medium and high income families, and with and without gainful employment outside the home.

In order to determine the consumers' preferences for food packaging, information was obtained on the homemakers' preferences for egg cartons, puffed rice cereal packaging, fluid milk containers, potato and apple packaging, packages of dry milk solids, and label information and container attributes of cans and jars. The nature of the criteria that consumers use in the selection of these food packages was investigated through the reasons homemakers expressed for their package preferences. Background data were obtained on the homemakers in order to investigate relationships between reasons for package preferences and the social and economic characteristics of the consumers.

Economy and convenience and other functional characteristics of the packages were important criteria in the homemakers' selection of a food package.

Convenience was one of the prime movers in the homemaker's selection of both 3 x 4 and 2 x 6 egg cartons, a rigid paper box container for puffed rice, both quart and half-gallon fluid milk containers and the packaged form for potatoes and apples. The age of the homemaker and the size of the family influenced the amount of emphasis that homemakers placed on convenience. Younger homemakers and those with larger families were more likely to emphasize convenience in their food package selection.

Other functional characteristics were important in the homemaker's selection of the paper box of puffed rice and the quart fluid milk container. Homemakers selected the paper box of puffed rice because it was better for maintaining the freshness and the quart container because it was better for providing the quantity most suitable to the family's needs. Although none of the social and economic characteristics of the homemakers appeared to be related to the emphasis on the package in maintaining the freshness of the cereal, the age of the homemaker and the size of the family were related to the importance of providing the quantity needed in selecting the quart fluid milk container. Older homemakers and those with smaller families were more likely to emphasize the latter reason in their selection of the quart container.

Economy was important in directing the homemaker's selection of a cellophane bag for puffed rice and of both the packaged and loose forms in purchasing apples and potatoes. Economy-mindedness was closely associated with a lower than average grocery expenditure per person and an interest in the quantity of food in the container.

In addition, whether homemakers had a preference between the egg cartons was largely a function of egg storage practices. Homemakers who removed eggs from the carton before storing them in the refrigerator were largely indifferent to the type of carton used for eggs. Whether homemakers used dry milk solids did not appear to influence their selection of the package most convenient to use.

There were no major differences in packaging preferences between homemakers who resided in either old or new housing areas. Neither were there any apparent differences between homemakers who were employed outside the home and those who were not so employed in emphasis on convenience.

Microfilm $2.75; Xerox $7.40. 156 pages.

A SYSTEMS ANALYSIS OF THE HARVESTING, CURING, AND MARKETING STAGES OF FLUE-CURED TOBACCO PRODUCTION.

(Order No. Mic 61-2295)

Lindon Uhle Cockroft, Ph.D.
North Carolina State College, 1960

Supervisor: William Douglas Toussaint

The central purpose of this study is to make an economic evaluation of alternative costs for various subsystems of flue-cured tobacco production with technology limited to the stages of harvesting, curing, and marketing. These stages required approximately 75 per cent of the 420 man-hours used to produce an acre of flue-cured tobacco by conventional methods.

Systems analysis is a logical framework for analyzing the complex problem of selecting least-cost production technologies. The term systems is meant to connote the interrelationship of subprocesses or stages in production, e.g., the harvesting, curing, and marketing stages. The data used in the analysis were obtained by engineering estimates of the experimental units, work sampling, and probability sampling.

The three stages, called a subsystem, are grouped into two economic stages--harvesting-curing and marketing. Nineteen technical stage alternatives were used to form 16 technical stage combinations within the harvesting-curing economic stage. Included in the harvesting and curing stages are all methods presently used on farms and experimental units such as the North Carolina State, mechanical harvester and Oxford-type and Clayton-type, bulk-curing units. From these alternatives, three least-cost technologies were identified for a range of zero to 54 acres production volume. Within the marketing stage, the three alternatives are tobacco tied on sticks, loose in sheets, and chopped tobacco.

The harvesting-curing alternatives that are least-cost over the volume range are: hand harvesting and barn curing at 1 acre, hand harvesting and Oxford-type bulk curing at 2 to 6 acres, and a tractor-mounted, 4-row, hand-priming harvester with Oxford-type bulk curing at 7 to 54 acres.

The results indicate that hand harvesting and an Oxford-type bulk curer with a capacity of 3.8 acres can reduce cost by $62 per acre (3.4 cents per pound of tobacco) compared to hand harvesting and barn curing. The labor requirements are reduced from 212 hours per acre for conventional harvesting and curing to 92 hours per acre when Oxford-type curing is used. Approximately 108 hours of labor for putting the leaves on sticks are eliminated. Other advantages of bulk curing include a reduction in the fire hazard and more uniformly-cured tobacco.

At 6 to 54 acres, the tractor-mounted, 4-row, hand-priming harvester with Oxford-type bulk curing requires 66 hours of labor per acre and reduces cost about $80 per acre compared to the conventional method. The maximum savings indicated are 34 per cent in the cost of the harvesting and curing stage and a 69 per cent reduction in labor hours. Using an 1800 pound yield, this amounts to 4.4 cents per pound of cured tobacco.

An isoquant-isocost analysis shows the stability of the least-cost technologies at various acreage levels for changes in the price ratio of labor and other inputs. Also, the reduction in labor inputs or other costs necessary to make cost methods of production equal in cost to the least-cost methods at various acreages are shown in the analysis. Microfilm $2.75; Xerox $6.20. 127 pages.

AN ANALYSIS OF CHANGES IN STRUCTURE OF HOG MARKETS IN NORTHEAST MISSOURI

(Order No. Mic 60-6801)

Charles Leonard Cramer, Jr., Ph.D.
University of Missouri, 1960

Supervisor: Elmer R. Kiehl

The very substantial changes in the livestock market structure have been associated with the general economic development of this country. Changes in the livestock market structure are important to the whole of society as they affect market behavior and performance in a significant sector of the economy.

In an attempt to describe the process of change in the livestock market structure, and particularly hog marketing,

a theoretical framework using three concepts of basic forces of change was developed. These concepts included the force of changing technology, the role of the innovator, and certain institutional factors. Changes in technology applied both within the marketing process and outside it in the field of production are causes of change within the market structure. Individual marketing firms may be thought of as economic organisms which live in an environment subject to change. Changes in the environment bring changes in the firms and in the structure.

To hog producers, the market structure is a tool which must be used by them to maximize their individual values. Firms that provide marketing services must be aware of the changes in the structure if they are to adjust to those changes. An understanding of the processes of change is necessary if future changes are to be predicted. If future changes can be predicted, firms and individuals can then anticipate the changes and reduce the maladjustment often characteristic of economic changes in the short run.

One aspect of the study of market structures involves the description of the number and characteristics of firms that are performing some specific marketing functions.

The empirical work which is reported in this paper was a description of the relative importance of markets of each type. The data were obtained from a mail survey of 2002 hog producers in a 33 county area in Northeast Missouri. In addition, several hypotheses relating selected characteristics of hog producing units to the use of markets of various types were tested. Data obtained by personal interview of a sample of 61 hog producers were used as a basis for developing estimates of characteristics of hog producing units at present and as projected into the future.

The relative use of various type hog markets was associated with the number of hogs sold and with age, depending upon distance from alternative market outlets.

Interest of hog producers in the production of meat type hogs and in obtaining price differentials which reflect value differences holds potential forces of change which could modify the market structure. Apparently, many hog producers were sufficiently impressed with the advantages of producing meat type hogs that they were attempting to make changes in that direction. They were also of the opinion that differential prices should exist which reflect differences in value of meat type hogs and other hogs. Evidence from the sample of 61 hog producers indicated that use of terminal markets and direct sales to packers were favored for meat type hogs. The sample was too small to generalize, but it did indicate that market preference of hog producers varied with the type of hog to be marketed.

On the basis of this study, it appears that, inasmuch as characteristics of hog producing units the type of marketing service needed and consequently the market structure, the following characteristics are important: hog producing units are tending to become larger; larger size producing units are associated with younger farm operators; producers have considerable interest in producing meat type hogs and expect price differentials that reflect differences in value of meat type hogs and other hogs.

Microfilm $3.25; Xerox $11.25. 249 pages.

INCREASING INCOME AND PRODUCTION IN INDIAN FARMING: POSSIBILITIES WITH THE EXISTING RESOURCE SUPPLIES ON INDIVIDUAL FARMS.

(Order No. Mic 61-1603)

Dhirajlal Keshavlal Desai, Ph.D.
University of Illinois, 1961

The problem of economic development in India is connected with the problem of development of the agricultural sector in the country. Although about 71 percent of the population is engaged in agriculture, the contribution of the agricultural sector to the Gross National Product is little less than 49 percent. Production per acre is lower than many other underdeveloped countries. There are many handicaps in Indian agriculture which impede development.

Many suggestions have been made as to how the agricultural production should be increased. Most of these suggestions are directed towards the need for improving the technique of cultivation. The present thesis is an attempt to investigate the possibilities of increasing farm income and agricultural production with the existing resources and the existing technical know-how of the farmers. For investigating such possibilities an hypothesis has been formulated in this thesis stating that there exists a substantial difference between the optimum income which can be obtained with the average technical efficiency by reorganizing the existing resource supplies and the actual income which the farmers obtain without a conscious effort to allocate their resources to maximize farm income.

A sample was carefully selected to test this hypothesis. Data collected in farm management inquiry in Ahmednagar and Nasik districts of Bombay State (now Maharashtra) in India were used for this purpose. These data gave the figures of estimated actual incomes which the farmers in the selected sample obtained during the year 1956-57. The data also gave the figures of resource supplies on the selected farms. The linear programming technique was used to find optimum income on each individual selected farm with the given resource supplies.

In the sample, 40 farms were selected, 20 from Ahmednagar district and 20 from Nasik district. Although both the districts formed a contiguous region in Maharashtra, climatic conditions in the two districts differ very much. The selected farms from Ahmednagar and Nasik were assumed to represent two different populations of farms. This assumption was verified by the statistical comparison of actual farm incomes of the selected farms in the two districts.

The selected farms were programmed with the given resource supplies on individual farms and the set of average prices and input-output coefficients for the areas in the year 1956-57. The mean difference between the paired values of optimum and actual incomes was found to be significantly greater than zero at 5 percent level and it was also significantly greater than the amount representing 20 percent of the average actual income in Ahmednagar and 90 percent of the average actual income in Nasik. This showed that there exists a substantial potentiality of

increasing farm income in the two districts of Ahmednagar and Nasik if the farmers were to allocate their existing resources according to optimum plans and were to operate at average technical efficiency.

The programming of individual farms in the sample showed that at an aggregate level it would have an effect of regional specialization.

If the farms were to adopt optimum plans there would be an increase in food production and cash crops as well. In the Ahmednagar sample food production could be increased from 695 maunds to 917 maunds. The optimum plans would produce double the quantity of sugar cane (gul) which is the main cash crop in the district. In Nasik, the optimum plans would increase the present groundnut production by two and one-half times and lucern by eight times without substantially decreasing food grain production.

Microfilm $3.40; Xerox $11.95. 262 pages.

DEMAND AND SPATIAL EQUILIBRIUM MODELS FOR FRESH APPLES IN THE UNITED STATES

(Order No. Mic 61-2314)

William Howard Drew, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor William H. Nicholls

The objectives of this study were to comprehensively analyze the structure of the United States apple market and to develop predictive devices that could be used by firms and agencies associated with the industry.

Because of improved production methods and specialized operations output has remained about constant in the face of a rapid decline in tree numbers during the past thirty years. Production has tended to concentrate in specific geographic areas thus increasing interregional shipments. A decline in home canning has been responsible for the increased consumption rate of processed apples while the greater variety and quantity of other fruits available during winter months has caused a sharp decline in fresh apple per capita consumption.

The fresh apple market comes quite close to meeting the requirements of perfect competition particularly on the Eastern Seaboard market where competition between producing areas is most severe. The annual quantity of fresh apples sold is considerably more stable than the quantity going into processing outlets. The latter apparently acts as a buffer in reducing annual price fluctuations on the fresh market at the farm level.

The demand elasticities for fresh and processed apples at the retail level were estimated by single and simultaneous equation methods. The parameters of two basic equations were estimated from a complete model consisting of ten endogenous and seven exogenous variables. The results obtained from the simultaneous solutions appear to be more consistent with economic theory and the real world.

The following estimates of the elasticities of demand at the retail level for fresh apples were obtained:

a. Price elasticity = -1.108

b. Cross-elasticity = +0.32
(relative to price of processed apples)

c. Cross-elasticity = +1.22
(relative to price of fresh oranges)

d. Income elasticity = +0.35

The following estimates of elasticities of demand at the retail level for processed apples were obtained:

a. Price elasticity = -0.73

b. Cross-elasticity = +0.67
(relative to price of fresh apples)

c. Cross-elasticity = -2.67
(relative to price of fresh citrus)

d. Income elasticity = +0.53.

Using the elasticities obtained in the demand analysis, equilibrium prices and consumption rates were obtained for 12 regions under the actual conditions existing during the crop years of 1949, 1953, and 1955. In most cases variation in consumer income levels and fresh citrus prices had a greater effect upon total revenue from fresh apples than did variations in the size of the crop.

With the equilibrium consumption rates established in the above analysis and with available production data it was possible to determine regional surpluses and deficits for the specific years. The techniques of linear programming were then employed to determine least-cost patterns of interregional flows for the specific years analyzed. The theoretical results were compared with the empirical data for 1953. Actual regional prices and interregional flows were quite similar to those produced in the model. The pattern of flows that occurred in 1953 resulted in a total transportation cost which exceeded that of the theoretical model by about one million dollars. The elimination of cross-hauling in the model was responsible for the greater portion of this potential saving.

One other further objective of the study was to determine the impact of changes in inter-state transportation rates. It was found that a 20 percent increase in transportation costs had very little effect upon consumption rates and the pattern of interregional flows.

The data and methodology presented make it possible to predict regional prices and consumption rates of fresh apples and a minimum-cost pattern of interregional flows. The industry could employ this predictive device as soon as pre-harvest estimates of regional production are available in any crop year.

Microfilm $3.60; Xerox $12.60. 277 pages.

TECHNIQUES FOR CHARACTERIZING OREGON SOILS FOR AGRICULTURAL PURPOSES IN TERMS OF PHYSICAL AND ECONOMIC PRODUCTIVITIES

(Order No. Mic 61-2421)

Sydney Carter James, Ph.D.
Oregon State College, 1961

Major Professor: Grant E. Blanch

This study develops techniques for characterizing Oregon soils for agricultural purposes in terms of physical and economic productivities. Physical productivity is

defined in terms of crop yields associated with individual soils. Measurement is by comparing yields of a single or group of crops produced on one soil with those of another. Economic productivity is in terms of net returns to the soil from a single or group of crops. It is measured by comparing the net returns of the single crop or group of crops of one soil with those of another. Physical and economic productivity ratings find greatest use through appraisal processes among tax assessors, real estate agents, farm loan agencies and farmers.

Marion County, Oregon, was selected as the source of data for developing and testing techniques which may be useful to Oregon as a whole. Information concerning soils and crops was collected by a farm survey. Farms were selected by means of a random point sampling system. Data were collected relative to land use, enterprise cost of production and product prices. Four hundred nineteen farmers were visited and 686 enterprise records collected. This accounted for about 20 percent of the total farm acreage in Marion County.

Crop distribution was calculated for each soil series studied. The percentage distribution relative to each soil-crop combination became the weighting factor when aggregating yields or net returns on individual soils. The distribution of crops relative to each soil was the most important single factor in separating the productivity of one soil from another. Another important factor in determining productivity of the soils was geographic location. Land use of individual soil series changed greatly from one area to another.

Average crop yields were calculated for each soil-crop combination. Crop yields were determined from farmer estimates of "usual" yields. It was determined that farmer estimated usual yields were above official averages for the whole county.

Physical productivity was determined for each soil by comparing crop yields on soils whose crop distributions were most nearly the same. Comparisons were on a percentage basis and were aggregated in terms of individual crop distributions relative to each soil. It was assumed that the crops which were compared accounted for 100 percent of the soil area.

Physical productivity indices determined for Marion County soils in terms of Chehalis soil were as follows: Chehalis 100, Newberg 97, Wapato 81, Willamette 94, Woodburn 94, Amity 90, Dayton 51, gravelly soils 81, Polk 76 and Aiken 71.

Economic productivity was determined for each soil by aggregating crop net returns on each of these soils by the percentage distribution of each soil-crop combination. Net returns to land was determined by the residual method. Only the net returns of those crops which accounted for over 1 percent of each soil area were included in the aggregation process. Economic productivities of the soils were determined in respect to the whole country and also to reflect geographic location differences.

Economic productivity indices determined for Marion County soils in terms of Chehalis soil were as follows: Chehalis 100, Newberg 126, Wapato 28, Willamette 111, Woodburn 71, Amity 49, Dayton 11, gravelly soils 59, Labish muck 306, Polk 31 and Aiken 45.

It was concluded that productivity determinations could be improved by: (1) increasing yield observations to eight per soil-crop combinations, (2) bringing yields in line with official average estimates, (3) budgeting general costs of production rather than determining these separately for each soil-crop combination and (4) using important crops to represent all crops of a related group rather than measuring productivity for each soil-crop combination in each group.

Microfilm $4.25; Xerox $15.10. 332 pages.

AN ECONOMIC APPRAISAL OF FARMING ADJUSTMENT OPPORTUNITIES TO MEET CHANGING CONDITIONS IN ECONOMIC AREA 7, NORTH CAROLINA.

(Order No. Mic 61-2304)

Robert Leroy Rizek, Ph.D.
North Carolina State College, 1961

Supervisor: William Douglas Toussaint

This study was concerned with farm adjustments and the aggregate consequences of these adjustments for Economic Area 7, an area in northeastern North Carolina characterized by relatively small farms and low farm incomes. Linear programming procedures were used in analyzing the various resource and price situations.

When farm acreage was restricted, the optimum enterprise combinations of the larger farms had larger quantities of enterprises which returned relatively more to labor than to land than did the smaller farms. Increases in the quantity of investment capital available resulted in the net incomes of the small farms being increased relatively more than those of the large farms. In addition, capital was restricting on the smaller farms even when the level of capital was increased to 70 per cent of the farm value.

When the restriction on farm acreage was lifted, optimum farm size was approximately the same for all single units. For most price combinations, the optimum cropland acreage needed by the different single-unit modal situations was between 120 and 145 acres. However, due to the smaller amounts of investment capital available and the cost of renting in additional cropland, the smaller units shifted to enterprises with relatively higher returns to land than to labor at lower price combinations than did the larger farms.

For situations in which cropland was unrestricted, enterprises requiring additional capital were included in the optimum enterprise combinations only at relatively low price combinations for cotton, tobacco, and peanuts.

The analysis indicated that with the number of croppers considered, the alternative multiple-unit situations were of optimum acreage. For multiple units in which the operator was engaged in farming, cropland acreage was increased by renting in land whenever the price level for peanuts was relatively high.

Two aggregation models were used to determine the aggregate effects of the estimated adjustments, especially the aggregate production response of cotton, tobacco, and peanuts. In the first model considered, it was assumed that the present organizational structure of the area remained unchanged. In the second model, it was assumed that cropper type farms disappeared. Consequently, only single-unit operations were included in the aggregation analysis of this model. In addition, it was assumed that

each unit would change to the optimum acreage derived by the programming analysis for each price combination.

Several alternative supply functions were derived for cotton, tobacco, and peanuts under the assumption of the two models by considering different price combinations for the major enterprises. The elasticity of cotton for these functions was between 3.0 and 6.0, except at very low and very high price levels. The elasticity for peanuts varied between .5 and 3.0, while for tobacco the elasticity varied between 1.5 and 3.0.

Microfilm $2.75; Xerox $5.40. 107 pages.

A STUDY OF HOG MOVEMENTS AND INTER-AREA PRICE RELATIONS IN THE SOUTHEAST

(Order No. Mic 61-2309)

Roy Glendon Stout, Ph.D.
North Carolina State College, 1961

Supervisor: Charles Edwin Bishop

The objectives of this study were: (1) to estimate hog movement patterns in the Southeast for one week in November, 1959, from survey data; (2) to estimate a least transport cost hog movement pattern from market areas to slaughter areas for the one week period; (3) to compare estimated actual and least transport cost movements for the one week period; (4) to evaluate the more important probable causes for deviations between estimated actual and least transport cost movement patterns; and (5) to measure inter-area price relationships and their effects on the location of market areas.

Marketings of slaughter hogs for the week of November 15-21, 1959, were estimated for 36 market areas in the six states of Virginia, North Carolina, South Carolina, Georgia, Alabama, and Florida. Commercial slaughter estimates were computed for 19 slaughter areas in these six states. Shipment patterns from market areas to slaughter areas were determined as well as average prices paid for the hogs in each of the slaughter areas. These estimates were derived from information collected from a sample of 104 meat packing plants, 85 auction markets and 35 buying stations.

The cost of hauling live hogs from markets to the meat packing plants by truck was estimated from rate information obtained from meat packers and livestock truckers. This estimated transportation cost was used to obtain a least transport cost movement pattern of the shipment of hogs from the market areas to the slaughter areas.

The estimated total cost of transporting hogs to slaughter for the actual movement pattern was about 14 per cent greater than the estimated total transport cost indicated by the solution of the least transport cost model. However, less than 65 per cent of the hogs actually were shipped over routes indicated by the least transport cost solution. The largest deviations between actual and optimum movements were in the coastal areas of the Carolinas and Virginia. Considerable numbers of hogs from the Carolina areas were shipped to Virginia for slaughter while large numbers of hogs were shipped into these same areas for slaughter from the mid-west.

The important causes for the deviations between the actual and optimum hog movement patterns were considered to be: (1) errors in estimating transportation costs; (2) inability of the least transport cost model to reflect the interrelations of short-run and long-run procurement operations; and (3) some real inefficiencies in movements.

The least transport cost model also yields imputed price differentials by areas. In comparing these expected price differentials with the actual differentials, taking eastern Virginia as the base area, three points of interest are worth noting: (1) the transportation cost and locational influence explained about 40 per cent of the area differences in actual average prices; (2) actual prices in the Carolinas and Virginia, relative to the base area, were higher than the expected prices, while in Florida, Alabama, and Georgia, the actual prices were less than expected; and (3) in the areas where large numbers were slaughtered and large numbers were obtained from the mid-west, the expected and actual price relations were very close. Microfilm $2.75; Xerox $5.80. 116 pages.

AN EVALUATION OF CONSUMER PREFERENCE AND THE EFFECTS OF PRICE VARIATIONS AND SELECTED FRUIT CHARACTERISTICS ON RETAIL SALES OF FLORIDA AVOCADOS

(Order No. Mic 61-2249)

Floyd Wendell Williams, Ph.D.
The University of Florida, 1961

The number of acres devoted to avocado production in Florida and the volume of the crop have increased steadily over the last decade. It has continually become more difficult for growers to market profitably this increasing volume of fruit. The purpose of the research for this dissertation was to provide the Florida avocado industry with information which would indicate (a) consumer response to price variation as reflected in the sales volume of avocados placed on retail display, (b) consumer preference for avocados having varying amounts of skin scab and scar when fruit was available at a range of prices, and (c) consumer preference for avocados having varying degrees of firmness. It was the objective of this study to provide the industry with pecuniary measures of consumer preference for these discernible characteristics of Florida avocados.

Data for this project were obtained in a five-week controlled retail store test in Philadelphia, Pennsylvania, in October and November, 1959. Displays of Florida avocados were placed in four modern supermarkets under controlled conditions specified by a latin square experimental design. Two of the stores were located in high-income residential areas and two were located in areas of medium income. Three separate but adjacent displays of avocados were maintained in all stores throughout the test period. One display contained fruit having 0- to 5-percent surface blemish, and two contained fruit with 15- to 25-percent blemish. Each display contained avocados which ranged from hard to soft. Prices were assigned to displays according to the degree of fruit blemish. Price treatments were rotated between stores each week. The display containing 0- to 5-percent blemished, or clear

fruit, was priced alternately at 17, 21, 25, and 29 cents per fruit. One display of 15- to 25-percent blemished fruit was always priced identical to the adjacent display of clear fruit. The other 15- to 25-percent blemished fruit display was always priced at 17 cents per fruit.

Avocado sales were recorded daily in each store. The price, degree of blemish, and degree of firmness of each fruit sold were noted. This provided a measure of consumers' preferences between clear and blemished fruit, firm, breaking, and soft fruit, and the price consumers were willing to pay to obtain avocados exhibiting the preferred characteristics.

Analysis of variance techniques were utilized in the statistical analysis of sales data. It was found that the income of store clientele, price, degree of blemish, and degree of firmness of avocados had a highly significant effect on the volume of avocados sold.

The high-income clientele purchased almost twice as many avocados as the lower-income clientele. Customers preferred clear fruit almost 2 to 1 over blemished at the same price. At a 4-cent differential in favor of blemished, they bought an equal volume of both. At an 8-cent differential, the ratio of blemished to clear sales was 1.4 to 1 and with a 12-cent differential, 1.8 to 1. Evidence indicated that customers prefer soft fruit for immediate consumption rather than hard fruit which must be stored until it is soft.

The following conclusions are based on findings of present and past avocado marketing research conducted by the Florida Agricultural Experiment Stations:

1. No significant preference exists for avocados of different shapes.
2. No significant preference exists for fruit of different sizes so long as prices are proportional to size.
3. Consumers have a strong preference for clear over blemished fruit.
4. High-income clientele are more familiar with avocados and use them more extensively than clientele of lower income.
5. Customers are quite sensitive to price changes, though less sensitive to price increases for clear than for blemished fruit.
6. Customers prefer breaking and soft fruit to that which is hard.

Microfilm $2.75; Xerox $8.60. 190 pages.

ECONOMICS, COMMERCE - BUSINESS

AN ANALYSIS OF THE LONG-RANGE PLANNING PROCESS IN A SELECT GROUP OF BUSINESS FIRMS

(Order No. Mic 61-2460)

Robert Howard Bock, Ph.D.
Purdue University, 1961

Major Professor: John S. Day

The term long-range planning has appeared only recently in the business literature. As of 1958, three major studies had been published. All three of these studies covered long-range planning extensively, but none of them determined a generalized, intensive explanation of long-range planning as an administrative tool.

Specifically, original research was required to (a) define long-range planning as businessmen perceive it, (b) describe long-range planning in a generalized fashion, so that a reasonably adept business manager could understand, and, if he desired, employ it in his company, (c) analyze long-range planning in a long-range system, which includes forecasting, risk, and uncertainty, and (d) suggest improvements to the long-range planning procedures presently in use.

An investigation methodology was employed. The following research questions were examined: (a) What constitutes the long-range planning process? (b) Can long-range plans be categorized? If so, how? (c) What are the criteria of long-range plans? (d) What functions are performed by the long-range planning process? (e) What are the determinants of the long-range planning process? No effort was made to prove or disprove answers to these research questions; they were used to structure the research inquiries in eleven business firms. The selection of the firms was not randomized. Case research was used exclusively. Therefore, the research results apply to the eleven firms and not necessarily to any others.

However, the author feels that the eleven firms happen to be reasonably typical of large companies in general; and, therefore, the research results can be applied across the board.

The term long-range planning alludes to planning activity and rational decisions designed to coordinate operations on a company-wide basis in response to changing external conditions. The coordinative function is not implied by the term long-range planning; but it was found that one particular kind of long-range planning activity, procedural planning, was devoted to coordinating decisions through a goal system and through a functional framework. Procedural plans coordinate decisions in the functional areas of volume, facilities, organization, and finance. The approval of top management insures that the recurring planning activity describes a long-range basis for operating decisions which are not inconsistent with the company's goals and objectives.

Venture planning is a second type of long-range planning. Venture plans, by and large, "factor" the environment into both policy-level and middle-management decisions. These decisions occur in acquisition planning, research planning, new product planning, and plant location planning. Venture plans are likely to alter the company's operations considerably over time. Long-range

planning in these areas charts a course for venture decisions so that the changes are consistent with the company's objectives.

Thus, long-range planning is distinguished by its rational, coordinative, and adaptive features. The criteria of long-range plans are, therefore, (a) objectives (primarily qualitative), (b) goals (primarily quantitative), (c) policies (generally restrictive), and (d) payoff measures for objectives, goals, and policies.

The long-range planning process described above operates in a long-range system. The system includes an analysis of the external changes which affect the firm.

The long-range planning process, which is alternately called growth planning, top-management planning, or corporate planning, will not guarantee profitable adaptation to changing conditions, but it will require that managers take "the long-range view." There is strong evidence that "the long-range view" can lead to growth, increased profitability, and survival.

Microfilm $3.35; Xerox $11.70. 259 pages.

THE DETERMINATION OF BUSINESS INCOME IN TIMES OF RISING PRICES

(Order No. Mic 61-1609)

Mohamed Nasr Habib El-Hawary, Ph.D.
University of Illinois, 1961

As the title indicates, the general objective of this study is the measurement of business income in periods of rising price levels. Since the start of the current period of general price increase, and particularly within the past ten years, there has developed a strong adverse criticism of the conventional measurement of business income. The critics allege that income computed by the use of established accounting principles is frequently misleading because it is computed without regard to the effects of changing price levels.

The accountant's measure of income is based on the assumption that the monetary unit of accounts is stable. This stability of value of the monetary unit invalidates the basic accounting assumptions and render conventional accounting income measurements inaccurate and dangerously misleading. As the general price level increases, a mixture in the income statement of dollars of different purchasing power usually occurs because costs are carried over from one period to be charged against the revenue of a later period. This results in a statement of monetary income rather than real or economic income. Moreover, the results achieved by matching historical cost with current revenue would be meaningless because efforts and accomplishments are expressed in unlike units. Thus, actual costs lose their significance during periods of rising prices and become uninformative to management, stockholders, and other interested groups. According to this line of thought, it is imperative that the fundamental accounting assumptions should always be subject to re-examination in the light of changing economic conditions.

The study stressed the problem of rising prices and its impact on the measurements of depreciation and inventory costs as they affect income accounting. It is believed that the problem of rising price levels reaches its most controversial stage in the matter of depreciation and inventory charges. Therefore, the nature of these two important items of cost and other related issues involved were discussed, analyzed and evaluated.

The study includes an investigation in the following general areas: a historical development of income accounting; a re-examination of the fundamental accounting assumptions in the light of changing economic conditions; concepts of business income are also examined, analyzed and evaluated; the problem of the measurements of depreciation and inventory costs; the problem of capital maintenance and income determination is also considered; and an evaluation of the merits and limitations of adjusted accounting data for price level changes have been analyzed. It was finally followed by an investigation of the reaction of labor groups to the problem of measuring business income in periods of rising prices.

It was therefore concluded that the monetary postulate is not appropriate in the measurement of business income in periods of rising prices. Adherence to the stability of this postulate has seriously impaired the validity and reliability of income so measured. It has been suggested that the index number adjustment method must be used for adjusting the depreciation and inventory costs. Concerning the problem of adjustment of accounting data, it has also been suggested that any justification for adjusting accounting data for price level changes must be based on the usefulness of the adjusted data which should not be applied without full recognition of their inherent limitations.

Much work remains to be done in developing new procedures for the use of price indices which are the only known statistical means capable of tying in original costs with the continually changing purchasing power of the dollar.

It has been recommended that some action should be taken by the American Institute of Certified Public Accountants and the American Accounting Association, or some other national organization to bring about a revision of the Internal Revenue Code which would give recognition to the changing value of the dollar in the measurement of business income.

Microfilm $2.95; Xerox $10.35. 228 pages.

DYNAMICS OF WHOLESALE TRADING AREAS

(Order No. Mic 61-2142)

Jac Landman Goldstucker, Ph.D.
University of Minnesota, 1961

The goal of the dissertation was to investigate the changing relationships among certain major wholesale centers and to determine the causes of these changes. There was a belief among some prominent Twin Cities wholesalers that forces at work in recent decades had brought about shifts in the coverage and relative importance of these trading centers. In order to determine whether this assumption was true, the following hypotheses were advanced:

The traditional trading areas of Twin Cities merchant wholesalers in selected lines; general-line

groceries, electrical apparatus and supplies, and hardware have shifted during the past twenty years. As a result, competitive relationships with firms located in other major wholesale centers also have changed.

There are factors which may be manipulated by individual wholesalers and by groups of wholesalers to enable them to alter their patterns of geographical coverage.

Factors may also be identified which explain why wholesalers in the same commodity field and located in the same centers operate over different geographical areas.

The focal point of the analysis was the Twin Cities and their competing wholesale centers. In addition to the Twin Cities, the author analyzed the changes in geographical coverage of firms in the following Metropolitan Areas: Denver, Salt Lake City, Spokane, and Seattle. Also, firms in Chicago, Milwaukee, and St. Louis were contacted to get some indication of the changes in their geographical patterns of coverage. The study covered a period of two decades, 1939-1957.

CONCLUSIONS: In the main, the trading areas of the major wholesale centers covered in the study have been relatively stable since 1939. This is true in spite of attempts by many firms to manipulate such factors as pricing policies, transportation charges, product differentiation, sales promotion, etc., to broaden their markets. However, since 1939, secondary wholesale centers have shown dynamic growth characteristics and have emerged in each of the primary wholesale trading areas. These newly-formed "pockets" result from growing population and from shifts in population from rural to urban areas; and they are tending to capture an increasing percentage of the wholesale trade in their respective regions.

Individually and collectively, wholesalers located in major centers have been concerned with competition from firms located in other major centers. The dissertation indicates, however, that only in relatively few cases have wholesalers been able to penetrate deeply into areas served by major competing centers on a continuing basis. Therefore, new competition within a given trading area is not from well-established wholesalers in other major centers but from wholesalers in the emerging "pocket" areas.

Based on current trends in population growth, it is reasonable to assume that secondary wholesale centers will continue to grow. It is undeniable that their growth is having an impact on the trade territories and sales volume of firms in the major Metropolitan Areas. Firms located in these major centers are being forced to adjust to this new market environment. An increased awareness and understanding of the emerging secondary centers will facilitate the adjustment. There is need for additional research to answer many questions as yet unanswerable about secondary centers. More complete knowledge can result in more competent executive decisions concerning this changing market structure and greater efficiency in resource allocation.

Microfilm $2.90; Xerox $10.15. 222 pages.

SURVEY OF INDUSTRIAL RELATIONS IN LEADING MICHIGAN ROAD CONSTRUCTION FIRMS

(Order No. Mic 61-2753)

George Joseph Gore, Ph.D.
University of Michigan, 1961

Although it has been estimated that labor accounts for approximately 30 per cent of the cost of road building, the human side of this multi-billion dollar enterprise has been neglected in industry literature. The major goal of this pioneering survey is to contribute information on this timely subject through a study of the industrial relations policies, practices, and problems of leading road construction firms operating in Michigan.

During the spring and summer of 1959, 79 personal interviews were conducted throughout the state. These were with 62 management personnel from 31 companies; 5 union officials, each representing one of the major unions involved; and related groups, such as the state highway department and the Michigan Road Builders' Association.

The dissertation is divided into three parts. Part I acquaints the reader with significant background information about the industry and about the study itself. Part II describes the functions and philosophy of the five road building unions and the employer associations, stressing the relationship between these groups. Part III reports on those aspects of personnel administration which are not covered by union contract.

Part III is based primarily on sixty-four questions which were asked management interviewees in the following areas: acquisition and adjustment of the work force; indoctrination, training, and promotion; wage and salary administration; fringe benefits; company services; safety; accident compensation; working conditions; personnel records; and employee satisfaction. The responses were brought together in statistical tables, were compared, and analyzed. Recommendations were made in view of over-all findings.

No single pattern of industrial relations policies and practices was observed within the surveyed firms--or for that matter could be recommended for all contractors. On the other hand, there were: (1) unique industry characteristics influencing all; (2) generally shared problems; (3) commonly accepted opinions and ways of meeting situations; and (4) similar opportunities for improvement.

The three industry characteristics having the most impact on personnel matters are: (1) seasonality, (2) the contract bidding system, and (3) decentralization of the work. The first two factors result in striking fluctuations in the work force, necessitating an abnormally large volume of hiring and discharge transactions. Since most "hires" are "rehires" it was recommended that a system using foreman ratings be devised to encourage the selection of proven good workers, thus upgrading the quality of personnel in each firm and reducing related turn-over costs--such as that for unemployment compensation. Because the work is decentralized, top management must rely heavily on middle and lower management. This indicates the need for more care in promotion

procedures, supervisory development, and the use of formalized company policies as aids in providing a high quality of leadership and direction on the job, and consistent treatment of employees. Job descriptions were suggested to assist management in wage and salary administration for non-craft personnel.

These were the major problem areas and major recommendations. Minor problems were found in the provision of fringe benefits and company services, safety and accident compensation, working conditions and employee records.

Union-management relations, although generally satisfactory, contained areas for improvement on both sides. Most obvious were two needs: one, for greater familiarity of contract provisions by first line supervision through foreman training, and a second, for the unions to refrain from placing demands on management which, if granted, could prove serious handicaps to operations.

The author's thesis is that these recommended improvements in the management of personnel in any one of these firms, and in its relations with labor unions, can result in competitive advantage for it, can yield greater profit for the owners and more satisfactory terms of employment for the employees. The resultant economies should also benefit the state and ultimately the taxpayers by reducing the cost of road building.

Microfilm $5.80; Xerox $20.50. 455 pages.

AN ECONOMIC STUDY OF THE UNITED STATES GLASS INDUSTRY, 1899-1947.

(Order No. Mic 61-1871)

Stephen Jeckovich, Ph.D.
University of Pittsburgh, 1961

This study undertakes an economic analysis of the glass industry from 1899 to 1947 with the dominant objective of developing guides for top management planning and control. Part A discusses the data used, defines the scope of the glass industry, and briefly explains the nature of its raw materials, manufacturing operations, and finished products.

Analysis of the glass industry's growth in Part B reveals that value of product and value added expanded fifteen-fold between 1899 and 1947, physical output increased ten-fold, while wage earner and salary earner employment increased by 100 and 150 per cent respectively. These long-term trends were reasonably stable, offering promising prospects for future market expansion. Although Burns' theory of retardation was not sustained by this industry's record, evidences of retardation were found in about one-third of the individual products, thus highlighting the need for sophisticated planning if over-all growth is to be maintained. As another aspect of growth, the number of glass plants experienced a steady decline totaling 30 per cent, while average plant size increased fifteen-fold. Conceivably, further increases in plant size, through centralization of facilities, may offer additional growth potential if management can cope with the problems of managing them. Finally, all growth measures, except number of establishments, experienced sharp fluctuations over the period, reflecting the impacts of business fluctuations, war, and technological innovations. Altogether, these growth measures reflect enough sensitivity and orderliness to offer prospects of serving as control and diagnostic tools for management.

Part C analyzed the major factors responsible for the glass industry's growth. Its ten-fold increase in output between 1899 and 1947 was influenced mainly by the 144 per cent increase in family numbers, by the 64 per cent increase in purchasing power per family, and by a residual 179 per cent increase in consumer "willingness to buy" glass products. Short-term changes in output were influenced primarily by changes in "willingness to buy" and in purchasing power per family. Thus, "willingness to buy" seems to have had the greatest long-term and short-term effect and is also the one factor, among the three considered, which is most amenable to influence by management. On the supply side, enormous technological advances converted the glass industry from a labor-dominated to a machine-dominated industry and provided production economies as well as the means of producing a much wider range of better products, to further stimulate market expansion. Although competition-restricting practices have been pervasive at times in the glass industry, governmental measures were reinforced by counter-attacks by those excluded from such arrangements in seeking to restore competition. It should be emphasized, however, that despite the frequent allegations of restricted competition, output rose twice as fast as in manufacturing as a whole and prices rose only one-fourth as much.

Part D shows that materials and wages each accounted for about one-third of total product value during 1899-1947, while salaries averaged 5 per cent and the residual of overhead, other costs, and profit averaged 27 per cent. Two trends were identifiable though: first, an increasing or decreasing proportion during the early part of the period, and second, an essentially horizontal trend during the latter part of the period. These relative magnitudes provide useful guides to cost reduction programs, while their relative stability provides useful guides for budgetary planning. Unit wage costs decreased by 11 per cent while unit materials costs increased by 78 per cent between 1899 and 1947, mainly because the 4.9 per cent average annual reduction in labor usage (man-hours per unit output) considerably outpaced reductions in material usage. This emphasizes the need for as intensive a material productivity program as took place in the labor field. Microfilm $6.15; Xerox $21.85. 483 pages.

THE ROLE OF THE DETAIL MAN IN THE DIFFUSION AND ADOPTION OF AN ETHICAL PHARMACEUTICAL INNOVATION WITHIN A SINGLE MEDICAL COMMUNITY

(Order No. Mic 61-1037)

Robert Richard Rehder, Ph.D.
Stanford University, 1961

Communications and opinion formation have developed into a major area of interest for business and behavioral science studies. In more recent years research in this area has pointed to the importance of interpersonal

relations in the communications and opinion formation processes. The American medical profession's unique formal and informal social structure, sophisticated forms of social control, and increasing reliance on and control of an innovation oriented pharmaceutical industry make this a particularly attractive research area. A review of the literature germane to this area indicates that the ethical pharmaceutical company's service representative, the detail man, is an important factor influencing the physician's innovation behavior; however, in all of the studies there is a conspicuous lack of research centered on the detail man and his functional interaction within the medical community.

The objective of this study is to analyze the part played by the detail man in the diffusion and adoption of a new prescription product within a single medical community. Ten major ethical pharmaceutical companies cooperated in the field work which included observations and notes of over 200 physician details. The research procedures were designed to reveal in-group attitudes and avoid the distortion of reference group behavior in order to identify and analyze the many variables which influence the physician's innovation behavior. The text begins with an analysis of the broad business and professional characteristics germane to the study and then concentrates on the corporation and the medical community which form the direct environment for the empirical research. The development and modification of the new product's marketing program is followed from its planning through actual introduction of the pharmaceutical innovation in the selected medical community. Particular emphasis is directed to the analysis of the interrelationships and functions of the numerous communication and opinion formation factors operating within the medical community.

The detail men's information function is indicated to be of primary significance in the introduction and diffusion of the ethical pharmaceutical innovation within the medical community. The detail men expedite communication by relaying information from both mass and interpersonal media and by filtering this information to support their new product. The continuing interpersonal relationships established by the detail men within the medical community facilitated their new product promotion by (1) providing greater access to the physician, (2) influencing the prescription decisions of certain physicians, and (3) providing control information on the physician's actual prescription choice. The existence of conflicting sets of role expectations for both the physician and the detail man is indicated.

The utilization of the detail men's established medical relationships revealed many non-objective factors influencing physician's prescription decisions which were significantly deviant from previous professional stereotyped responses to non-medical inquiries. The detail men's unique interaction with both mass and interpersonal medical communication channels further suggests that factors influencing the physician's opinion formation cannot be effectively evaluated by statistical sampling of respondents treated as isolated individuals.

Microfilm $2.95; Xerox $10.35. 228 pages.

APPRAISAL OF STOCK OPTIONS AS AN INCENTIVE DEVICE – A STUDY OF THEIR USE AND ABUSE.

(Order No. Mic 61-2224)

Emmett Wallace, Ph.D.
Columbia University, 1961

Restricted stock options are alleged to have a unique incentive effect on corporate employees who receive them. The preferential tax treatment accorded to optionees by Congress in 1950 was justified on the following grounds: (1) options enable an executive to increase his proprietary interest and thereby inspire greater effort in behalf of the corporation; (2) options provide a means for attracting new management talent and for holding present employees. This study attempts to appraise the incentive effect of restricted stock options.

As background, the judicial, administrative and legislative history of the restricted stock options provisions are traced. This is followed by a review of the past decade's experience with stock options---their varying prevalence in different industries, the more common features of stock option plans, and their administration.

The cost of stock options to the optionors defined as the differential between option price and market value on date of exercise, is studied in relation to income and employment costs of selected companies. Costs vary widely depending upon the number of shares optioned and the extent of share price appreciation, but has totaled as much as ten percent of a firm's net income.

The effectiveness of options in increasing ownership by managers is studied. It is noted that executives have sold substantial portions of the shares purchased in many instances. This is attributed in large part to the widespread use of self-financing options which force optionees to sell shares in order to repay loans or to exercise additional options. The sale of shares by optionees cannot per se be regarded as failure of executives to develop an interest comparable to the interest of shareholders, however, since the holder of an option who owns no shares may still have an incentive to increase the value of his firm's shares.

Past studies of the magnitude and determinants of executive mobility are reviewed as a prelude to an analysis of mobility in selected firms which have granted stock options. This study reveals that a large portion of the optioned stock, in some instances more than half, has gone to senior executives in their fifties and sixties who show little likelihood of changing employment, options or no options. Judging from this sample, a very minor portion of optioned shares, relative to the total value of shares optioned, are used to attract new executives.

Since optionees are rewarded by share price appreciation, this appreciation is taken as the measure of incentive effect. The changes in share prices of thirty-seven optionor firms are compared individually with thirty-seven paired non-option firms taken as a control group. The Pitman Test is applied to determine significant differences in relative appreciation and significant changes in rates of appreciation which might have resulted from the use of options. No significant difference in share price performance was found between paired firms: although fourteen optionor-firms showed a relative share price appreciation greater than their mates, nineteen optionor-firms showed

a relative appreciation less than their mates. In almost all instances, the higher rates of appreciation for one firm or the other since adoption of the stock option plan was found to be associated with a higher rate of appreciation experienced prior to grant of the stock options.

It is concluded that stock options give no evidence of a unique incentive effect which might justify the present preferential tax treatment. They do seem to have some incentive value, however, which stems from two non-proprietary qualities: (1) the receipt of options and their size reflect status and (2) their favorable tax treatment raises after-tax income.

If restricted stock options are not eliminated legislatively, their use should at least be limited. Their size should be small enough to avoid the self-financing option which may encourage a short-term outlook. Moreover, their use should be limited to executives whose taxable income is greater than $64,000, because below this amount it is cheaper for the corporation to give an executive the same after-tax income by salary than by option.

Microfilm $3.20; Xerox $11.05. 245 pages.

ECONOMICS, FINANCE

A HISTORICAL STUDY OF THE EFFECTS OF INFLATION ON THE MARKET FOR BONDS

(Order No. Mic 61-1344)

Roland Thomas Mullins, Ph.D.
University of Arkansas, 1961

Major Professor: Harold A. Dulan

The basic objective of the study is to gain more insight into what effects, if any, inflation can be expected to have on the future market for bonds in the United States if inflation continues, and what bond features may facilitate the sale of bonds during inflation. Intermediate objectives are to determine what effects inflation had on the market for bonds in each of the countries studied, and the bond features used in attempts to sell bonds during inflation.

The method of achieving this objective was to analyze the effects of inflation on the market for bonds in two countries--France and Brazil--which have had inflation over long periods of time, as well as to analyze the experience of the United States itself. France and Brazil were chosen for study on the basis of several requirements set up by the author, with the idea that a detailed study of a few countries would be of more value than a survey of several. An attempt was made to transfer the conclusions of the French and Brazilian studies to the United States bond market, after making due allowances for important differences between the economies.

For purposes of the study, inflation is defined in terms of the equation of exchange, $MV = PT$, where M = the money supply, V = its velocity of circulation (excluding the financial circulation), P = the commodity price level (as measured by wholesale and cost-of-living price indices), and T = the volume of transactions. Inflation is defined as any increase in P, or any change in any of the other factors in the equation which might tend to produce an increase in P.

Monetary inflation was found to be the immediate cause of price inflation in both France and Brazil, resulting from central government deficit spending and the loose credit policy of the banking system. The market for bonds was never completely destroyed in France, although volumes sold were depressed and yields forced considerably above yields on comparable stocks. Index bonds, bonds the yield and/or maturity value of which are tied to some price index, became important during the 1950's, as a direct result of the inflation. This type of bond salvaged the previously failing market, most bonds now sold in France being indexed in some manner.

The Brazilian market for bonds has been almost completely destroyed by inflation of a more rapid character than French inflation. Other than extremely high yields, Brazilian bonds were not found to contain any features to enhance their marketability during inflation. The Brazilian market was more severely affected by inflation due to (1) the earlier stage of development of the economy, especially its financial institutions, and (2) the more rapid inflation.

Two general patterns of possible future United States inflation were considered: (1) creeping price inflation of the 1948-59 variety and (2) more rapid price inflation, resulting from deliberate governmental and/or central banking policy, or lack of policy. Future pattern (1) inflation can be expected to cause a continuation of the 1948-59 trend away from bonds by investors, resulting in relatively higher yields. Future pattern (2) inflation would tend to produce more drastic changes, such as experienced by France and Brazil. Investing institutions and individuals can be expected to demand some type of purchasing-power protection. While the question as to their long-run effects on the economy was not considered, index bonds may be useful and expedient for capital formation during inflation of this type.

Microfilm $4.20; Xerox $14.65. 325 pages.

ECONOMICS, THEORY

THE EMPLOYMENT OF LABOR AND THE COST OF CAPITAL IN MANUFACTURING INDUSTRIES AS THEY ARE RELATED TO WAGE CHANGES AND TECHNOLOGICAL PROGRESS

(Order No. Mic 61-2151)

Ronald Ian McKinnon, Ph.D.
University of Minnesota, 1961

The relationship of wage changes and technical progress to the degree of labor intensivity which is optimal to use in industrial processes, is of interest in many areas of economic analysis. Such information should prove useful for studies in employment, income distribution, and inflation. The traditional approach to this problem is to specify the form of a production function for an industry in such a way that both labor and capital are treated as homogeneous inputs. This has created the problem of

measuring capital stocks which are actually heterogeneous and, from a theoretical point of view, made it difficult to treat economic effects such as distributed lags which, themselves, can be traced to the inherent heterogeneity of capital.

The model presented here describes the cost structures of individual manufacturing industries by making two strong but fairly reasonable assumptions about the nature of the economic environment: (1) once capital equipment has been created and installed, the labor used per unit of output remains fixed; (2) the exante choice of different processes with different degrees of labor intensivity before installation by entrepreneurs, can be represented by a continuum each point of which has different capital costs associated with it, i.e., as labor intensivity per unit of output falls, the corresponding capital costs rise for any fixed technology. Under these crucial assumptions, the nature of substitution possibilities can be described and measured with existing data, without requiring estimates of capital costs, and without assuming anything further about the nature of the market structure.

A statistical model is presented which allows estimation of the equilibrium relationships of the economic model from data which are not, themselves, assumed to be in equilibrium. This is done by making an assumption about the nature of movements of variables toward equilibrium which was first used statistically by Marc Nerlove, i.e., the rate at which variables move towards their equilibrium position is proportional to their distance from it. The last section involves the use of this technique to estimate the parameters in the economic model for U. S. manufacturing industries at the two-digit level for the time period 1947-1958. A wide divergence of estimates for the relative substitution possibilities in different industries in response to wage changes is found as well as a divergence in the rates of technical progress. Some implications of these results are drawn.

Microfilm $2.75; Xerox $3.80. 66 pages.

EDUCATION

EDUCATION, GENERAL

THE NEEDS OF DAIRY FARMERS IN AGRICULTURAL MECHANICS IN SELECTED DAIRY COUNTIES OF NEW YORK

(Order No. Mic 61-1089)

William Henry Annis, Ed.D.
Cornell University, 1961

Purposes. (1) To test the hypothesis that there were no statistical differences among selected dairy counties in the manipulative jobs performed by sampled dairy farmers. (2) To determine the manipulative jobs performed in agricultural mechanics on dairy farms by the owner or regularly employed help. (3) To ascertain those manipulative jobs performed by servicemen. (4) To determine the value to the farmer of knowing how to perform the jobs. (5) To develop a suggested training program of manipulative abilities in agricultural mechanics for students of vocational agriculture in the sampled dairy areas of New York.

Methods. The mailed questionnaire technique was used to secure the data from 182 of 236 dairy farmers in six counties of New York having over 1,000 dairy farms per county. The questionnaire of 148 manipulative jobs was developed from readings, personal knowledge, and consultation with agricultural education and agricultural engineering personnel, as well as teachers of agriculture. A pre-test was conducted with selected farmers in two counties. The farmers were asked to check the appropriate column to indicate: (1) the jobs performed by themselves or regularly hired men; (2) the value of these jobs to present and prospective farmers; (3) those jobs performed by servicemen; and (4) those jobs which the servicemen performed which the farmer felt should be done by farm personnel. The samples from the counties were compared by use of the chi square technique to determine the statistical differences which existed among the counties regarding the jobs performed by the farmers or servicemen.

Twenty-four teachers of agriculture were asked to respond to the same 148 manipulative jobs to ascertain when they felt these jobs should be offered in the training program.

Findings. There were no significant differences among the counties relative to the manipulative jobs performed by dairy farmers when compared by using the chi square technique. On the basis of these findings, it was concluded that a training program of manipulative jobs in agricultural mechanics for the sampled dairy areas could be developed.

The areas of agricultural mechanics ranked in order of importance to farmers were: (1) farm machinery; (2) farm power; (3) farm shop; (4) farm buildings and conveniences; (5) electricity; and (6) soil and water management. The farmers normally performed the service and maintenance functions in the area of farm machinery as well as the adjustments on the machines. They generally had servicemen perform the overhaul functions.

Farmers performed the jobs which had high labor requirements in the area of farm buildings, with servicemen performing the installation functions in this area. The farmers performed most of the manipulative jobs in the area of farm shop themselves but rated welding low in importance.

A training program was recommended based upon the number of farmers who performed the job, its value to farmers, and the number of farmers who indicated they felt they themselves should be performing jobs which they now hired servicemen to do. These jobs were placed in the training program according to the

year recommended by a concensus of the opinions of the sampled teachers of agriculture.

Microfilm $2.75; Xerox $9.00. 198 pages.

A STUDY OF THE DEVELOPMENT OF THE SPECIAL EDUCATION PROGRAM IN KANSAS, AND AN EVALUATION, WITH EMPHASIS ON THE PROFESSIONAL PREPARATION OF SPECIAL EDUCATION PERSONNEL.

(Order No. Mic 61-2329)

Joseph Junior Eisenbach, Ed.D.
Wayne State University, 1960

Adviser: John J. Lee

The purposes of this study were:

1. To review historically the major educational and legislatorial developments which both preceded and followed the establishment of the Kansas special education program.
2. To determine the professional preparation and experience of Kansas special education personnel.
3. To develop a prototype which may be used by other states in developing and evaluating special education programs.
4. To offer recommendations to improve the Kansas special education program.

Educational and legislative developments which occurred before 1949 revealed that: (1) by 1904, residential institutions were established for deaf, blind, mentally deficient, epileptic, and incorrigible children; (2) special education for exceptional children was primarily confined to state residential institutions; (3) compulsory school attendance and child labor legislation increased the holding power of the public schools; moreover, as rural schools were consolidated, and as rural population decreased and urban population increased, the need for special education became increasingly apparent; (4) an impetus to provide special education for exceptional children resulted from studies made by governor-appointed commissions, private organizations, and educational leaders. Developments from 1949 to 1957 included: (1) the enactment of legislation which provided for the establishment of the Division of Special Education and a director thereof; (2) the organization of special programs and services beginning in 1951 and extending to June, 1957; (3) the establishment of collegiate training programs for special education personnel; and (4) evolution of certification and approval standards.

The professional preparation and teaching experience of Kansas special educators (N = 125) was determined. The population was composed of eighty-three special teachers of educable and trainable mentally retarded, orthopedically and visually handicapped, and homebound children; and forty-two ancillary personnel, including thirty speech correctionists, eight school psychologists, three hearing conservationists, and a school social worker. As of June, 1957, all of the ancillary personnel and 82 per cent of the special teachers held bachelor's degrees. Fifty per cent of the former and 25 per cent of the latter had earned master's degrees. Fifty-nine per cent of the total population completed a course on the survey of exceptional children. None of the teachers of exceptional children completed more than fifteen semester hours of specialized courses. Twenty-nine per cent of the teachers of educable mentally retarded had no specialized training in the area of mental retardation. Every ancillary worker had completed course work in this area of specialization, and approximately 80 per cent completed more than twenty-one hours of specialized course work.

Forty-eight per cent of the special teachers and 14 per cent of the ancillary personnel were over fifty years of age. Ninety-three per cent of the teachers had regular classroom teaching experience, and 57.6 per cent of the experienced teachers had taught in a rural school. A total of 30.9 per cent of the ancillary personnel had regular classroom teaching experience, and 11 per cent had taught in a rural school. In general, annual salaries of special teachers were lower than salaries paid to ancillary personnel.

Institutionalization in Kansas has evolved from a total custodial function to a multifunction approach including prevention, care and treatment, education, and rehabilitation. Public schools have been unable to provide adequate diagnostic and therapeutic facilities to meet the needs of school-age children. Therefore, while school attendance and child labor laws increased the holding power of the schools, sufficient provisions have not been made to identify and provide educational experiences for exceptional children.

Recommendations for improving the program include:

1. Administer visual, auditory, and group psychological examinations to each child enrolled in the public schools.
2. Eliminate the minimum age of admission to special education programs.
3. Establish regional offices for state special education supervisors.
4. Develop more classes for educable mentally retarded children between the chronological ages of six and nine and sixteen and twenty-one years.

Microfilm $3.75; Xerox $13.30. 291 pages.

THE EFFECT OF THE USE OF A PARTICULAR METHOD ON ACHIEVEMENT IN PROBLEM SOLVING IN SIXTH GRADE ARITHMETIC

(Order No. Mic 61-2120)

Charles Joseph Faulk, Ed.D.
Louisiana State University, 1961

Supervisor: Professor Thomas R. Landry

The study was concerned with the effect of a particular method on problem solving achievement in sixth grade

arithmetic. Participating in vocabulary exercises, talking through problem situations, diagramming or illustrating the problem, estimating the answers, and writing solutions were phases of the method. Personnel from eleven parishes of the state cooperated with a member of the State Department of Education in conducting the study. Twenty-two teachers and seventy-four pairs of students participated in the study for eighteen weeks.

Method. Procedures used in conducting the study were as follows: (1) parishes were selected on the bases of the series of textbooks in use, and the willingness of school personnel to participate; (2) teachers were selected and paired on the bases of degrees held, years of teaching experience, and their proficiency as teachers; (3) students from self-contained classrooms were paired with students from similar classrooms within each parish on the bases of age, sex, intelligence quotient, and arithmetic achievement; (4) supervision for the study was provided by local supervisors and the state elementary supervisor; (5) the control group used techniques recommended in the teacher's guide of the Making Sure of Arithmetic series, and logs were kept when techniques used varied from those recommended in the guide; (6) the experimental group followed a plan which included suggestions for vocabulary exercises, opportunities for talking through problem situations, diagrams and illustrations of problems, estimating answers, and writing solutions to the problems.

The California Test of Mental Maturity and the California Arithmetic Reasoning Test were administered to both the control and the experimental groups in September, 1959, and the California Arithmetic Reasoning Test was administered again in January, 1960. Results of these achievement tests were tabulated and presented statistically for the total group of seventy-four pairs of students who represented the eleven parishes. Students within the seventy-four pairs were ranked according to grade placement and subdivided into the upper, middle, and lower thirds so that differences in mean gains within these smaller groups could be analyzed statistically. Finally, conclusions based on the findings were reached.

Results. Data for the control and experimental groups were evaluated. For the control group the following facts were revealed. Mean gains for the upper, middle, and lower thirds of the paired students were five-tenths, six-tenths, and seven-tenths of a year, respectively. For the experimental group the following facts were revealed. Mean gains for the upper, middle, and lower thirds of the paired students were seven-tenths, nine-tenths, and eight-tenths of a year, respectively. For all seventy-four pairs, mean gains for the control group were six-tenths of a year and for the experimental group, eight-tenths of a year.

Conclusions. The conclusions which follow seem justified on the basis of the data gathered during this study.

1. The experimental procedure was effective. All experimental groups made gains of seven-tenths or more years in four months of study.
2. Control group procedures were also effective. Every control group made gains of at least five-tenths or more years.
3. The experimental procedures seemed slightly superior to the control group procedures. Whereas the differences in mean gains slightly favored the experimental groups, only the mean gains of the total group were significant at the .10 level.
4. Further experimentation with a larger sample and a longer period of time is needed to determine whether the experimental procedures used in this study are consistently superior to procedures used with the control group.
5. Further experimentation is needed in the area of learning problem solving.

Microfilm $2.75; Xerox $6.20. 130 pages.

AN INVESTIGATION OF THE SUITABILITY OF SIX READING SELECTIONS DESIGNED FOR SIXTH-GRADE PUPILS

(Order No. Mic 61-2331)

Thomas Gray Foster, Ed.D.
Wayne State University, 1960

Adviser: Marion Edman

Purpose

The purpose of this study was to investigate the suitability of six selections written for sixth-grade pupils in the Detroit Public Schools. A second purpose was to determine whether teachers, who know children, but who have limited or no experience as authors, could successfully produce curricular materials designed for a specific grade.

The criteria set up for purposes of analyzing the selections were three in number. If the selections were suitable for sixth-grade use they would be: (1) of approximately sixth-grade level as shown by application of readability formulas, (2) interesting to sixth-grade children as shown by several methods described within the study, and (3) comprehended readily by children with sixth-grade reading ability as determined by comprehension tests.

Procedures

The six reading selections, which were produced by a committee of Detroit teachers and assistant principals, were first examined by the use of readability formulas. Both the Lorge and Dale-Chall formulas were applied to each selection and the resultant readability grade levels recorded.

Following this, the selections were read by a carefully chosen group of thirty children who had been determined to have sixth-grade reading abilities through the use of Iowa and Stanford reading tests. In an effort to assess interest in the selections, they were presented in pairs to the children, who chose the more interesting one of each pairing. The children also assigned an interest mark to each selection, and as they had read only the first 1000 words of each selection, stated whether or not they wanted to read the entire selection.

The children were timed in their reading of each selection, and were given a short comprehension test on each. All these data were recorded and used in the analyses of the selections, to determine their suitability for use in sixth-grade classrooms.

The procedures used in this study are readily adaptable to other situations and other materials, and may be used by educators who wish to evaluate locally prepared curricular materials.

Findings

Data secured through application of the two readability formulas indicated that four of the six selections were within the desired readability range, that one was slightly below the desired level, and one slightly above. Data secured through the children indicated that four of the six selections were completely acceptable on the basis of pupil interest and comprehension, but that two of the selections had relatively low interest ratings. Comprehension of all selections, as determined by the comprehension tests, ranged from satisfactory to excellent.

Conclusions

Taken as a whole, the six selections should prove satisfactory for use in the sixth grade of the Detroit Public Schools. Some revision will be required and should be accomplished prior to publication of the selections in booklet form. Based on earlier research, the selections are closer to the required readability grade level than are many textbooks and materials which have been published and are currently in use.

The second problem posed by this investigation concerned the ability of teachers, who had limited or no experience as authors, to produce curricular materials designed for a particular grade. This must be answered in the affirmative, for in this case, at least, the authors came reasonably close to their mark in writing for sixth-grade pupils. More research of this type is necessary, however, before a conclusive answer to this problem may be reached. Microfilm $2.75; Xerox $7.80. 170 pages.

AN INVESTIGATION OF FACTORS CONSIDERED IN THE SELECTION OF APPRENTICES BY MANUFACTURING COMPANIES IN MICHIGAN

(Order No. Mic 61-2335)

Richard H. Hagemeyer, Ed.D.
Wayne State University, 1961

Adviser: G. Harold Silvius

Purpose of the Study

To inventory factors considered in the selection of apprentices and to determine the relative importance of each. Specific objectives were to provide information for: (1) use in the development of more effective counseling and guidance programs, (2) study and evaluation of education's contribution to the preparation of individuals for entry into apprenticeships, (3) use in the development of related instruction curriculums congruent with the abilities and capacities of the apprentices selected, (4) a guide for management and labor in the establishment of new apprenticeship programs or the improvement of existing ones, (5) increasing knowledge of skilled manpower in the United States and Europe.

Procedure for Conducting Study

Data were obtained from a stratified random sample of those Michigan manufacturing companies with apprenticeship programs. Selection factors studied were: relative importance of personal and educational qualifications; maximum age limits for applicants; rank importance of selected factors observed during probationary period; standardized tests used; importance attached to test results, and minimum mean score necessary for consideration as an applicant.

Conclusions of the Study

1. Neither seniority in the company nor family relationship in the trade were prime requisites to insure consideration as an applicant for apprenticeship training.
2. Possession of the manipulative skills needed to be immediately productive on the job was considered important especially if the applicant applied for an apprenticeship in a small company. Evidence of a good work experience record was also considered a valuable asset for an apprenticeship applicant.
3. Hobbies which reveal interest and aptitude in mechanical things were considered important in the selection of one applicant over another.
4. Companies in four of six geographical apprenticeship areas in Michigan considered recommendations furnished by an applicant's school important in apprentice selection.
5. Recommendations from previous employers were considered very important in both large and small companies in selecting apprentices.
6. Recommendations from friends or acquaintances were not considered important by the large manufacturing companies. Small companies in two regions, however, considered such recommendations important.
7. Although high school graduation was practically a requirement to being selected as an apprentice by the manufacturing companies in Michigan, a record showing an applicant's relative success in school, as evidenced by his grades was considered of lesser importance.
8. High school students planning to apply for apprenticeship in Michigan's manufacturing industries should be encouraged to take courses in algebra, geometry, shop mathematics, and industrial education while in school.
9. Opportunities to obtain apprenticeship training are no longer the exclusive province of youth in Michigan's manufacturing industries. Many companies accept applicants in their late twenties and will transfer even older seniority employees into the training program--providing they possess the capabilities, interest, and have compiled a good work record.
10. Michigan's manufacturing companies generally used a probationary period as the final phase of the selection procedure.
11. Standardized tests were used by many large companies as an initial screening device. Most small companies, however, make selections without the benefit of knowing an applicant's potential as indicated by scores on mechanical aptitude, mental ability, and specific skill tests.

12. Companies that reported the use of standardized tests in their selection procedures have established minimum standards which would discredit the thesis that individuals who are mentally unable to pursue other occupations should learn a trade.
13. Michigan's manufacturing companies, with a few exceptions, were not facing up to their responsibilities for providing trained craftsmen to replace those now in their employ who will be lost to the trade by death and retirement.
14. Only 3.59 percent of small manufacturing companies in Michigan maintained apprenticeship programs.
15. Any large increase in the number of apprentices being trained in Michigan must be achieved by the development of programs in those companies not presently maintaining an apprenticeship program.
16. United States industries can no longer depend upon the immigration of highly skilled craftsmen from Europe to meet the increasing need for skilled manpower.

Microfilm $3.40; Xerox $11.95. 262 pages.

A STUDY OF STUDENT-INSTRUCTOR RELATIONSHIP AT THE COLLEGE LEVEL

(Order No. Mic 61-1494)

Carlton Lester Krathwohl, Ph.D.
Syracuse University, 1960

Supervisor: Edwin D. Smith

Purpose

This research into the nature of student-instructor relationships in college teaching was designed as a descriptive and quantitative study. It was developed for the purposes of:

1. defining the dimensions of student-instructor relationships in college teaching;
2. determining whether or not instructors' concepts on student-instructor relationships formed a pattern or were individualistic;
3. determining whether or not the instructor's behavior in student-instructor relationships was consistent with his expressed concepts;
4. experimenting with the clinical procedures of interviewing and observation as a method of gathering data on the problem being studied;
5. applying a method of data analysis, namely, White's "Value-Analysis," to information obtained through clinical techniques; and
6. developing a type of research study which would be applicable to self-evaluation of the instructor's effectiveness in student-instructor relationships at the college level.

Procedures

The procedures and techniques which were employed included:

1. an interview between the instructor and the investigator to obtain the instructor's verbalized concepts on student-instructor relationships in college teaching;
2. observations made by means of reported behavioral incidents and by means of a structured observation rating sheet both of which were obtained from students as well as instructors;
3. ratings on the structured observation ratings scales and on a student opinionnaire both of which were obtained from students as well as instructors;
4. class observations by the investigator;
5. content analysis by means of White's "Value-Analysis"; and
6. statistical analysis employing significant differences of percentage ratings and significant differences of means.

The panel of participating instructors consisted of 29 faculty members representing seven departments at Syracuse University and including all instructional ranks. Approximately 1100 undergraduate students from 29 different classes contributed to the study.

Findings and Conclusions

The findings were reported in illustrative case studies as well as quantitative data, statistically treated. Some dimensions of student-instructor relationships were indicated. Both variability and consistency of the instructor's behavior with his expressed concepts were reported. The effectiveness of the techniques of interviewing and observations for this type of inquiry was reported as favorable. Content analysis by means of White's method was considered useful. Diversity of expressed concepts on student-instructor relationships as well as observed behavior was noted. No common pattern on the part of the individual instructor was reported. There were some indications that with this particular group of participants, variability according to subject taught, or within an academic discipline was present. The value of the techniques used seemed to be established as a useful research method in this type of self-evaluation project in college teaching. The testimony of the participating instructors indicated its usefulness.

Implications for Future Research

Additional research efforts seem indicated from this study of which the following are examples:

1. verification and further definition of student-instructor relationships in college teaching;
2. identification of the most effective means of gathering and analyzing data regarding student-instructor relationships;
3. development of more exacting instruments for measurement in this aspect of college teaching; and
4. determination of the effectiveness of the individual instructor's criteria as opposed to the common denominator type criteria used most frequently at present.

Valuable research continues through such endeavors as the "Teacher Characteristics Study," but future investigators must produce an acceptable definition of effective teaching, especially in this aspect of student-instructor relationships. They also must determine the most useful measures of effectiveness in teaching and measure against the individual's criteria. A continuing vexation to all who engage in this field of research is the definition and measurement of that intangible aspect of human nature which is inherent in the teaching process.

Microfilm $2.75; Xerox $9.70. 212 pages.

A MANUAL FOR THE ADMINISTRATION OF RECREATION PROGRAMS FOR MENTALLY DEFECTIVE CHILDREN IN STATE INSTITUTIONS FOR MENTAL DEFECTIVES. (PART ONE: THE RESEARCH. PART II: THE MANUAL, RECREATION FOR THE MENTALLY RETARDED).

(Order No. Mic 61-733)

Jesse Mayo Lamm, Ed.D.
New York University, 1959

Chairman: Associate Professor Edith L. Ball

The purpose of this study was to develop a manual for the administration of recreation programs for mentally defective children in state institutions within the United States.

The study was divided into two parts: the research and the manual. The research was divided into four subproblems: the identification of the current status of recreation programs for mentally defective children in state institutions; the establishment of recreation needs of the mentally defective; the identification of the internal administrative factors within the institution which would have influence on the conduct of a recreation program for mentally defective children; and the establishment of recreation principles which may be used as a guide in the development of recreation programs for institutions for mentally defective children. Part two was the development of a manual on recreation programs for mentally defective children in state institutions.

The problem was limited to a study of state institutions and the retarded residents of these institutions. It primarily dealt with the age group which ranged from six to forty years.

The study was developed with the basic assumption that recreation should be an essential part of the education and training of mentally defective children to aid in optimum development.

Two questionnaires were used in the study to determine the current status of recreation and to identify the internal administrative factors which influence recreation programs. A jury was chosen to validate the construction of the questionnaires. Jury members had a minimum of ten years' experience in recreation or an allied field and a minimum of a masters degree.

The recreation needs of the retarded were established through a survey of the literature on recreation for the retarded and related material. The needs that were derived were validated through supportive data which included direct statements of needs by experience professionals who work with the retarded who published articles in professional journals.

A survey of the material on recreation served as a basis for the development of principles of recreation for work with defectives. These principles were stated to apply to the retarded and institutional recreation programs. They included principles for the following areas: philosophy, organizations and auspices, people served, program, leadership, administration and professional standards. A jury of experts was used to validate and adopt these principles. The jury members had a minimum of a masters degree and ten years' experience in recreation, part of which was work with defectives in institutions.

The manual was based on the data received as a result of the four stated sub-problems. It included chapters on philosophy, recreation needs of the retarded, administrative factors which influence recreation programs, finance, leadership and administration, basic facilities and equipment, and adapted programs and methods that have been successful in work with the retarded. The manual was written in simple and well defined terms to meet the needs of non-professionals and volunteers who work with the retarded and still have value for professionally trained recreators.

This study added material to a field that had been sorely neglected in terms of written material. Only one study of this type has been published since 1931 and that was specifically geared to program areas or activities. This study included all areas necessary for the establishment of recreation programs for the retarded in a state institution. It will serve as a basic text for the development of recreation programs in any state institution for the retarded who seeks aid from the literature in the field of recreation.

Microfilm $4.60; Xerox $16.20. 359 pages.

A STUDY OF STATE LAWS AND STATE EDUCATION DEPARTMENT REGULATIONS FOR SAFETY EDUCATION IN THE PUBLIC SCHOOLS OF THE UNITED STATES

(Order No. Mic 61-2575)

James Fredrick Nihan, Ed.D.
New York University, 1961

Fatal accidents in the United States total about 90,000 annually. In a recent year such deaths claimed the lives of 19,000 school-age youngsters. Much of this loss is due to unsafe practices, improper attitudes and lack of safety education.

Studies have revealed a need for legal stimulation of safety education. Legislation designed to stimulate industrial accident prevention has had beneficial results. Statutes and regulations fostering safety education in the schools could also be valuable.

The purpose of this study was to evaluate existing safety education laws and regulations and to make recommendations for their improvement. The laws were compiled from official statutes. The regulations were abstracted from state education department publications.

Forty-eight states have legislation and nineteen have regulations affecting at least one major phase of safety education. None of them have legislation or regulations pertaining to all phases. Several state education departments use the laws in lieu of regulations. Evacuation drills are covered by law in thirty-four states, by regulations in nine. Twenty-four states have laws regarding driver education, fifteen have regulations. General safety education is included in the laws of twenty-three states, in the regulations of fourteen. Fire prevention education is legislated in eighteen states but covered by regulations in only one state. Safety patrols are provided for by law in twelve states, by regulations in four. Statutes provided for by law in twelve states, by regulations in four. Statutes providing for traffic safety education were found in eleven states, regulations in only three. Civil defense education is affected by legislation in three states, by regulations in five. Six states have laws dealing with education in firearms safety.

Many laws fail to provide flexibility for local initiative and adaptability. There are conflicting standards among the states and within states. Many codes were ambiguous as to authority and responsibility. Several states' regulations are hortatory rather than regulatory.

The laws and regulations identified were abridged and the major provisions refined into separate evaluation instruments. A panel of seven state education administrators evaluated the provisions in the instruments and applied to each item a qualitative rating of Excellent, Good, Fair or Poor. The judges rated 5.4 per cent of the legal items Excellent, 21.7 per cent Good, 15.5 per cent Fair, and 11.1 per cent Poor. They rated 35.9 per cent of the regulatory items Excellent, 9.4 per cent Good, 2.8 per cent Fair, and 14.2 per cent Poor. The remaining items failed to receive a majority rating in any of the established categories. The judges favored existing regulations over laws. They accepted more prescriptive details in the regulations, but consistently criticized excessively prescriptive or inordinately permissive items.

A quantitative value was applied to each of the four evaluation terms. To be recommended, an item required two-thirds of the maximum value attainable. The following recommendations reflect the fundamental principles contained in the twenty-six legislative and forty-one regulatory items which qualified. Safety education laws should: 1) require all schools to offer instruction in the several phases of safety; 2) authorize state education departments to regulate the details of such instruction; 3) authorize the expenditure of school funds for safety instruction; 4) avoid prescribing the details of safety instruction; 5) not mandate that non-educational agencies participate, regulate or control education functions; 6) refrain from providing special financial support for certain phases of safety instruction; and, 7) not involve the schools, directly or indirectly, in the granting of licenses or permits. Safety education regulations should: 1) establish the basic framework within which school districts may adapt safety instruction; and, 2) provide uniform minimum standards relative to granting credit for safety courses, time devoted to safety instruction, distribution of safety education funds, grade levels for such courses, and the extent of participation by non-educational agencies. Microfilm $4.50; Xerox $16.00. 352 pages.

THE STATUS OF TEACHERS OF THE EDUCABLE MENTALLY RETARDED

(Order No. Mic 60-6187)

Annette Louise Rich, Ph.D.
University of Pittsburgh, 1960

Supervisor: Donald L. Cleland

The purpose of this study was to ascertain the status of teachers of the educable mentally retarded. Five basic elements were studied, namely, the supply and demand of teachers; the personal background of the teachers; professional background of the teachers; state requirements for special certification to teach the mentally retarded; and state legislation pertaining to teachers of the mentally retarded.

The normative survey method was employed in obtaining the data. Two questionnaires were composed for the study. The questionnaire pertaining to the supply and demand of teachers of the educable mentally retarded was sent to the administrators of the special education programs in the 181 cities in the United States selected for the study. One hundred and forty-nine (82.5 per cent) administrators completed the questionnaire and also submitted the names and addresses of the teachers in their school districts. The questionnaire concerning their personal and professional background was sent to 823 teachers. Replies were received from 579 (70.5 per cent) teachers. Data concerning certification and legislation were obtained from the State Departments of Education.

Some of the principal findings are as follows:

More special classes for the educable mentally retarded are needed in 72 per cent of the cities. The reasons given by the largest percentage of administrators for not having as many classes as needed were: (1) budget limitations, (2) insufficient classroom space, and (3) difficulty in recruiting qualified teachers. The methods of recruitment found the most successful were: (1) encouraging regular teachers interested in the mentally retarded to become prepared to teach a special class, and (2) inquiring at the placement bureaus of colleges that offer programs in special education.

Eighty-nine per cent of the administrators recommend previous teaching experience in the regular classes prior to teaching a special class for the mentally retarded. In 35 of the cities the experience is required.

The mean age of the teachers was 43.6 years. Seventy-nine per cent of the teachers were women.

The mean salary received was $5025. Thirty-five per cent of the teachers received a salary differential. The differential ranged from $15. to $600. per annum.

Sixty-two per cent of the teachers chose to teach special classes for the mentally retarded because the work is more interesting and challenging.

Only 12 per cent of the teachers would prefer to teach regular classes.

Four of the teachers have a doctor's degree and 45 per cent have a master's degree.

Sixty-nine per cent of the teachers are certified to teach the mentally retarded.

The mean number of years of teaching special classes for the mentally retarded was 7 and the median was 4.79.

One-half of the teachers taught classes of 15 pupils or less and 11 per cent had classes of 20 or more.

Thirty-six states have certification requirements for teachers of special classes for the mentally retarded. The total number of semester hours of specialized and related course work specified by each state ranges from 6 in the State of Maine to 40 in Illinois.

Forty-five states have legislation providing financial assistance for local school districts maintaining special classes for the mentally retarded.

The conclusions for the study are as follows:

The wide gap between the number of qualified teachers needed for special classes for the educable mentally retarded and those available presents a major obstacle for school administrators interested in expanding their present programs to meet the needs of more mentally retarded children. However, the majority of the administrators have maintained high standards by selecting only teachers who have the necessary personal and professional qualifications for the position.

The trend seems to be towards more certification for teachers of special classes for the mentally retarded, and also towards more specialized preparation.

There is an increasing interest in the education of the mentally retarded as reflected in the amount of recent legislation pertaining to this particular group.

Microfilm $4.25; Xerox $14.85. 330 pages.

A CRITICAL ANALYSIS OF ATTITUDES OF SELECTED ELEMENTARY STUDENTS TOWARD TELEVISION TEACHING IN THE DETROIT TELEVISION TEACHING PROJECT

(Order No. Mic 61-2341)

Dezo Vincent Silagyi, Ed.D.
Wayne State University, 1961

Adviser: Marion Edman

PURPOSE

The purposes of the study were: (1) to survey the attitudes of selected third, fourth, fifth, and sixth grade pupils relative to teaching by television, and (2) to analyze these reactions for possible implications for the future modification of television teaching procedures.

The study was concerned with the investigation of pupil attitudes toward: (1) television teaching in general, (2) the physical setting, (3) personal relationships, (4) personal achievement, and (5) technical and production aspects of television teaching.

SOURCE OF DATA

The experimental population consisted of 2,840 pupils enrolled in larger-than-normal classes in eight schools in Detroit, Michigan. Subject areas were: third grade conversational French; fourth grade conversational Spanish; fifth grade conversational Spanish, Science, and Health; and sixth graders who had viewed Science and Health in 1958-1959.

METHODOLOGY

Several exploratory instruments were devised, tested, evaluated, and revised prior to the formulation of the final Pupil Opinionnaire. The responses of the pupils were transcribed, punched, sorted, and tabulated by means of IBM equipment.

An exhaustive Chi Square analysis was utilized for tests of significance and independence among the various categories. Pupil responses were also analyzed by individual schools, individual questions, pupil comments, and choice of favorite subjects.

MAJOR FINDINGS

Significant responses of the total population in the area Television Teaching in General indicated the following pupil's opinions:

1. It was easy to learn by television.
2. They liked to discuss the television lesson with their viewing teachers.
3. They had to listen more carefully to an on-camera teacher than to a classroom teacher.
4. They did not become restless or tired during television class.

In selecting their favorite subject, the television classes French, fourth grade Spanish, and Science were ranked in the upper half of the continuum while fifth grade Spanish and Health were ranked in the lower half.

In the area of Physical Setting, the pupils did not feel that there were too many children in their television class nor that the five television sets bothered them in the Auditorium. However, approximately half of the total population indicated they would like to watch their television class in the Homeroom while the remaining responses were divided between Auditorium and other non-Homeroom classes.

Opinions of the pupils in the area of Personal Relationships were as follows:

1. The viewing teacher knew their names.
2. The viewing teacher knew the kind of work they were doing in television class.
3. Their neighbor did not bother them more in the television class than in their other classes.
4. They could obtain help if they did not understand the daily television lesson.
5. The on-camera teacher talked directly to them.
6. Their friends felt they were "lucky" to be in a television class.

In reference to Personal Achievement, the pupils reflected the opinion they were learning as much by television as they would if they were taking the identical subject in a regular class. Eighty per cent of the pupils said they saw more interesting things on television than in a

regular classroom, and sixty per cent agreed it was easy to remember the things they saw and heard on television.

Pupil opinions pertaining to Technical and Production Aspects indicated:

1. Their on-camera teacher did not go too fast.
2. They would like to be on television with their on-camera teacher.
3. They had the opportunity to ask questions in their television class.
4. Children on television helped to make the lesson more understandable.
5. They could see objects more clearly in a regular classroom than on the television screen.

Comments of pupils indicated a request for a longer Science program, more experiments, more project days, more interesting subjects, color television, discontinuing of Spanish, better cameramen, better focusing of television cameras, and more close ups of projects.

The writer feels that a continuous study of pupil attitudes toward television teaching is necessary and will provide information vital to program improvement.

Microfilm $2.75; Xerox $9.00. 196 pages.

THE RELATIONSHIP BETWEEN PATTERNS OF READING INSTRUCTION AND READING ACHIEVEMENT IN THE PRIMARY GRADES

(Order No. Mic 61-2539)

Florence Boyd Sperry, Ed.D.
University of Southern California, 1961

Chairman: Professor Brown

This study undertook to identify and evaluate three widely used primary reading instruction patterns—the basal, the individualized, and the unclassified—in promoting reading achievement of primary grade children.

The instrument used for securing the data was an 80-item questionnaire submitted to three groups of respondents: (1) 42 Southern California specialists and/or administrators in elementary education in schools involved in the study, (2) 30 reading instruction specialists in other parts of the nation, and (3) 145 first, second, and third grade teachers. The local and national educators comprised a jury. The purpose of the jury-questionnaire was to develop an instrument by means of which to classify the instructional orientation of teachers of elementary reading. Item analysis of jury responses yielded a Reading Instruction Scale of 35 items interpreted as discriminating substantially between the basal and the individualized reading patterns. Each teacher in the study received both a basal and an individualized score as determined by the Reading Instruction Scale. The scores were converted into an Index of Instructional Bias. The reading instruction program of each pupil was identified by the instructional bias of each of his teachers. On this basis, ten possible pupil classifications were obtained. Comparative analyses were made of the groups in terms of the following variables: (1) mental ability, (2) socioeconomic status, and (3) reading achievement. The data concerning these factors were then examined for salient relationships between basal, individualized, and unclassified reading instruction patterns.

Findings. In determining the relative effectiveness of basal, individualized, and unclassified patterns of reading instruction in promoting reading achievement at the primary level, a significant hierarchy of achievement was observed. The individualized pattern was definitely superior to the other two patterns, the unclassified being superior to the basal pattern. These data indicate that the individualized pattern of reading produced significantly greater third grade reading achievement. The same superiority held true when the socioeconomic variable was analyzed in terms of the three patterns. No significant differences were exhibited in the mental ability of the children when separated according to reading orientations.

Conclusions. (1) In promoting reading achievement in the primary grades, the individualized pattern is significantly superior to the basal and unclassified patterns. (2) The individualized pattern in the primary grades does provide for readiness to read and for the reading skills of word recognition, comprehension, and study skills. (3) Individualized reading can be taught effectively by experienced teachers, and not necessarily by just superior teachers. It can be taught with average numbers of children and with materials available in school district libraries and curriculum offices. (4) Imposition of a systematically controlled vocabulary in teaching reading to first grade children fails to take into account the wealth of communications with which today's children are surrounded. A richer vocabulary is indicated. (5) This study made some inroads into the problem of classification of teachers' reading orientation by objective means.

Recommendations. (1) Those responsible for curriculum planning in the primary grades should consider seriously the merits of the individualized reading pattern. (2) Individualized reading instruction should be considered for children of all socioeconomic levels and of varying intelligence levels.

Microfilm $5.40; Xerox $19.15. 423 pages.

A DESCRIPTION AND COMPARISON OF SELECTED CHARACTERISTICS AND QUALIFICATIONS POSSESSED BY FULL-TIME, PUBLIC SCHOOL, CLASSROOM TEACHERS AND THE NEW TEACHERS EMPLOYED IN MISSOURI DURING THE 1958-59 SCHOOL YEAR.

(Order No. Mic 61-2286)

Donald Mouzon Van Devander, Ed.D.
University of Missouri, 1961

Supervisor: Howard W. Heding

Purpose: The purposes of this study were (1) to obtain an objective description of the 4,375 new public school, classroom teachers employed in Missouri during 1958-59; (2) to obtain an objective description of the 28,775 public school, classroom teachers employed in Missouri during 1958-59; and (3) to compare the new teachers with the total population of teachers as to sex, teaching level, degree held, salary, number of college semester hours, number of years of teaching experience, type of teaching certificate held, and whether or not the teacher was certificated specifically for what teaching.

Method of Research: Data were obtained from IBM teacher data cards and the annual Application for Classification at the State Department of Education, the IBM teacher data cards of the Public School Retirement System of Missouri, and records of the Kansas City Public School Retirement System.

Summary:

(1) Three-fourths of the total teacher population employed in Missouri during 1958-59 were women; one-fourth were men.

(2) Of the 4,375 new teachers employed during 1958-59, 63.95 per cent were women; 36.05 per cent were men.

(3) Women teachers outnumbered men teachers in Group A (total population) by 8 to 1 in elementary schools, but on the secondary school level the ratio was almost 1 to 1. In Group B (new teachers) the ratio of women to men in elementary schools was approximately 7 to 3, whereas on the secondary school level the ratio was about 3 to 2.

(4) Approximately 80 per cent of Group A and B teachers had college or university degrees.

(5) The average age of Group A teachers was 43.37 years; of Group B teachers, 35.05 years.

(6) In Group A the average age of women teachers was 45.41 years; of men teachers, 37.21 years. In Group B the average age of women teachers was 36.40 years; of men teachers, 32.01 years.

(7) Salaries received by Group A teachers ranged from $1,200 to $9,600 with an average of $4,312. Salaries received by Group B teachers ranged from $1,400 to $7,700 with an average of $3,733.

(8) The average salary of Group A men teachers was $4,697; for women teachers, $4,193. The average salary of Group B men teachers was $3,920; for women teachers, $3,628.

(9) The number of college semester hours completed by Group A teachers ranged from 4 to 382 hours. The range of college hours completed by Group B teachers was from 16 to 282 hours.

(10) The average number of college hours completed by the Group A teachers was 140.97; by Group B teachers, 134.42 hours.

(11) Group A and B men teachers had completed more college hours, on the average, than either Group A or B women.

(12) Group A teachers averaged 14.67 years of teaching experience; Group B teachers, 5.53 years.

Conclusions:

(1) Men teachers in Missouri are, on the average, better qualified and prepared than women.

(2) Group B teachers (new teachers) are better qualified than rumors would indicate.

(3) Group B men teachers are better qualified and better prepared than Group A men teachers, on the average.

(4) A minimum of 1 per cent more teaching jobs for each year for at least the next 10 years will be available for the new teachers.

(5) Salaries paid to over one-half of the teachers of Missouri are below the salary suggested by the Missouri State Teachers Association.

(6) College and university guidance programs have been deficient in aiding prospective teachers to plan properly for earning the baccalaureate and master's degrees.

Microfilm $4.55; Xerox $16.20. 356 pages.

EDUCATION, ADMINISTRATION

A STUDY OF CERTIFICATION STANDARDS IN RELATION TO THE DUTIES AND RESPONSIBILITIES OF THE TENNESSEE HIGH SCHOOL PRINCIPALSHIP

(Order No. Mic 61-817)

Floyd Lester Bass, Ed.D.
University of Colorado, 1960

Supervisor: Professor H. H. Mills

This study sought to: (1) ascertain from the literature, research studies, and the judgment of a jury the major professional duties which should be assumed by high school principals; (2) study the major professional duties of Tennessee high school principals; (3) compare the major professional duties of Tennessee high school principals with those duties ascertained from the literature

and appraised by the jury; (4) study the procedures used in selected states to initiate and administer a program of certification for high school principals; and (5) develop recommendations for the certification of Tennessee high school principals.

The review of professional literature provided information concerning the role of the high school principalship. A check list of 102 duties of high school principals was submitted to a jury of twenty-five selected authorities in the field of high school administration. This check list was also used to study the major professional duties of principals in seventy-six Tennessee high schools with fifteen or more teachers, and ranging in enrollments between three hundred and three thousand students.

The review of research literature provided information concerning certification requirements for the high school principalship in the various states. A check list of sixty-four techniques for initiating, implementing, and improving certification regulations was submitted to twenty-seven chief certification officers in states issuing an administrative certificate for high school principals.

The areas of duties of the high school principalship as revealed in the literature can be classified as follows: (1) administrative, (2) supervisory, (3) guidance, (4) public relations, (5) teaching, (6) clerical, and (7) other miscellaneous duties.

The variety of duties which were revealed in the literature and performed by Tennessee high school principals were considered as desirable, in the following order, according to the responses of a majority of the members of the jury: (1) visit new teachers and other personnel when it is necessary; (2) assign teachers to classes; (3) make unscheduled visits in all of the classes; (4) keep teachers and other employees informed regarding the purposes and policies of the school; (5) study the interests, abilities, talents, experiences, and training of staff members; (6) regulate, permit, or prohibit advertising or exhibits in the building; (7) plan, conduct, and follow up the results of individual conferences with teachers; (8) make scheduled visits in all of the classes; and (9) transfer or recommend the transfer of a teacher from one position to another.

Upon the basis of the findings of this study the following recommendations were made for the certification of secondary school principals in Tennessee:

The secondary school principal's certificate should be required for all principals seeking employment in high schools after its adoption in Tennessee. The certificate should be issued by the State Department of Education only on the basis of a recommendation by the graduate school which awarded the prospective principal a master's degree in secondary school administration. Prospective principals of schools, grades seven through twelve, should submit evidence of a minimum of three years of successful teaching experiences in these grades.

The graduate program in secondary school administration should include a minimum of ten semester hours of professional study including high school administration and supervision. The graduate program should include a four-month period of internship in a secondary school. Two years of graduate study including the master's degree in secondary school administration should be required for a permanent administrative certificate.

Microfilm $2.80; Xerox $9.70. 213 pages.

WAREHOUSING IN ELEMENTARY SCHOOLS

(Order No. Mic 61-2525)

Holly Wester Colby, Ed.D.
University of Southern California, 1961

Chairman: Professor Nelson

The purpose of this study was (1) to investigate and analyze the policies and procedures pertaining to the warehousing of supplies in selected public elementary school districts, (2) to determine what problems are encountered in the establishment and maintenance of an efficient warehouse, and (3) to develop a set of standards which may be used as a guide toward the establishment and operation of efficient and economical school warehouses.

The method of study was of the normative-survey type. Districts in Los Angeles and San Diego counties were studied through visitation and interview. A questionnaire to teachers and principals in these districts confirmed their functional efficiency. From these interviews and the literature, a list of recommended practices was developed. Those practices receiving approval of a jury of specialists were set forth as a set of standards.

Findings. (1) The school district governing board's function in the area of warehouse operation and supply management should be the establishment of policies, the exercise of broad general control, and the approval or disapproval of purchases recommended by the superintendent and his staff. (2) The warehouse operation is so closely related to procurement operations that supervision of warehousing should come from the purchasing rather than the accounting department. (3) Equipment delivered directly to schools because of weight or bulk should be received and accepted by warehouse personnel, or other personnel under direction of the storekeeper, at the requisitioning school. (4) To insure property control and accurate accounting of supplies, access to the warehouse should be controlled by the issuance of warehouse keys only to certain warehouse personnel. (5) To obtain additional warehouse space in the most economical and practical way, new warehouse construction should provide for high ceilings, concrete floors, and power lift equipment to permit higher stacking of supplies. (6) Because of the role supplies play in teaching, the selection of instructional supplies to be warehoused and considered as standard supplies should be accomplished through committees with representation from all the following groups: the persons who will use the supplies, supervisors, purchasing specialists, and administrators. (7) A district should have a clearly established procedure for reporting inferior or defective items to the purchasing department. (8) Medium-sized and larger districts, particularly those with purchasing departments, should buy the different classes of supplies such as paper products and athletic, custodial, health, or art supplies at intervals throughout the year to permit more careful study of the items and better preparation of the formal bid and to avoid peak work loads. (9) Determination of supply needs should be made by consideration of previous experience, anticipated changes in enrollment, and program and policy changes of the district. (10) To avoid shortages of supplies, a

minimum stock level figure should be determined for each warehoused item. This minimum figure should be compared with the balance on hand at regular frequent intervals or each time stock is reduced. (11) In order to maintain a current inventory and to avoid stock shortages, inventory records should be adjusted before the order is filled. (12) Delivery of supplies from the warehouse to schools should be on a definite schedule known to all. (13) The inventory should be maintained by the business office.

Conclusions. (1) Efficient operation of the warehouse is an important factor in a school district's supply distribution system and thus essential to achievement of an optimal instructional program. (2) The practice of using for storage purposes antiquated classrooms declared unsafe for housing pupils has contributed to delay in development of modern, efficient warehousing operations in many school districts. (3) No set of recommended practices will in every instance apply equally well to large and small districts.

Microfilm $2.85; Xerox $9.90. 219 pages.

A PROPOSED PERFORMANCE FORMULA FOR THE REIMBURSEMENT OF THE SCHOOL DISTRICTS OF PENNSYLVANIA FOR EXPENDITURES FOR PUBLIC SCHOOL PUPIL TRANSPORTATION

(Order No. Mic 61-2364)

Ralph Eugene Coleman, Ed.D.
The Pennsylvania State University, 1961

Problem. The primary aim of this study was to develop a justifiable formula which would reflect a reasonable cost basis for the distribution of State aid to public school districts for transportation purposes.

Subordinate to this problem, but closely allied to it, was a study of such factors as district wealth, school bus size, the relation of district-owned to contract transportation costs, and the State's share of the cost of transportation by using the proposed formula.

Procedure. This study was primarily descriptive, since it was not possible under existing laws to make an experimental study of the application of the proposed formula for reimbursement. Mathematical calculations were completed for many of the school districts of the State and a comparison was made of the expenditures of the districts for pupil transportation and those payments that would have been made by using the proposed formula.

Many of the data used in the study were compiled from the annual application for reimbursement forms submitted by the various school districts for the 1957-58 and 1958-59 school years. State totals were compared with national totals with respect to cost of transportation, number of buses, ownership, and per pupil costs. Correlations were determined between costs and numbers of pupils, costs and mileage, costs and time, and costs and pupil density, in order to ascertain the factors that should be used in a reimbursement formula.

Publications of the Pennsylvania Department of Public Instruction were examined, and State employees were interviewed in a search for relative merits of district-owned bus transportation and contracted bus transportation. The literature was reviewed and related research was identified and compared with the present investigation.

Conclusions. Because of factors indicating a high relationship to pupil transportation costs, it was possible to arrive at a formula which could be used by the State to allocate transportation funds. The formula enables directors of local boards of education to select the type of operation best suited to the local needs, since the same formula is used for both district-owned and contracted operations. Above all, it can operate impartially with respect to all districts. The major components of this formula are overhead costs, driver's wages, operation costs, and administration costs.

A definite relationship was found to exist between the bus size and the cost of transporting public school pupils. The relationship showed that large buses were operated at lower costs per pupil than small buses.

It was also concluded that the contract method of operation was favored over the district ownership method of operation in the present allocation of State funds. This accounts in part for the high percentage of contracted vehicles in Pennsylvania's public school pupil transportation program.

The cost to the State under the proposed formula would be comparable with the actual cost under the present method of reimbursement.

If the proposed formula developed in this study was adopted and placed into operation, district ownership of the transportation system would be more favored than at present. This would lead to a trend in district ownership of vehicles similar to the national trend and to a more economical pupil transportation program.

Microfilm $2.75; Xerox $6.80. 141 pages.

A STUDY OF THE DEPARTMENT HEAD IN THE COMPREHENSIVE HIGH SCHOOL

(Order No. Mic 61-1)

Benjamin Jacob Cook, Ed.D.
Rutgers University, 1960

This was an investigation of the position of the department head in secondary education. Professional textbooks, public school surveys, reports of learned societies, and special studies of the position were examined with a view to discerning the various aspects of the position.

Expressed opinions and findings of practice as reported in the above data have been used as a basis for portraying the role of the department head in achieving the established goals of the existing instructional pattern. Particular attention has been focused upon organizational structure as opposed to the subject-centered and the major purpose-centered curriculums.

The Problem

It was the purpose of this study to examine and analyze the background, the duties, the functions, and the

organizational status of the department headship in public secondary schools in the light of current concepts of the purposes and organization of the comprehensive high school as practiced in secondary education today.

Procedures

An extensive search was made for studies related to the problem in the Education Index, the Review of Educational Research, city and state educational surveys, and doctoral dissertations accepted by American universities.

The basic bibliography included thirty-eight professional texts on school administration and supervision, one hundred fifty articles from professional periodicals, three doctors' dissertations, two master's theses, fifteen city school surveys, two state surveys of education, three studies of reorganization in specific high school situations, ten national surveys of secondary education, two national, one state and two sectional surveys of the department headship, two studies on supervision, and one department head's manual.

These references were examined to determine (1) the historical and organizational development of the position of department head, (2) the reported effectiveness of the department head organization in achieving set goals in either of two instructional patterns, and (3) the conditions reported which made for the success or lack of success of the department head. Tables were prepared to indicate the expressed opinions of authors in regard to various phases of the department headship.

General Findings

The position of department head has been the oldest of assistantships in our secondary schools, beginning before the middle 1800's.

The traditional secondary school organization which included the department head and teachers of single subjects has encountered difficulty in the crossing of subject matter and departmental lines, thus the major purposes of secondary education could not be accomplished through specialization in subject matter.

The change of focus from subject mastery to major purposes in secondary education has developed questions in instructional pattern and organizational structure for achieving the goals of high school. Generalization, rather than specialization, has become the pattern of instruction in an effort to develop the "whole child."

Conclusions

Past practice and experience tend to indicate that process-centered organizations lend themselves to specialization. Specialization divides labor and develops workers into specialists whose skills become limited to a single process or activity. The department head originated in this type of organization and has served with credit as a supervisory medium where close supervision or inspection of process is necessary to insure strict conformity.

Evidence points to the department head as an adoption from industry into the secondary school organization as early as the middle 1800's. In education, this position has contributed to subject supervision by maintaining excellence in the mastery of subject matter. In the past this procedure has been considered as standard practice for all students, in particular, those desiring to enter college.

The department head, properly equipped, and usually an expert in his subject, has been prone to direct his interest and efforts toward engendering proficiency in his subject in both teachers and students. His position, according to organizational structure, was that of a line officer with responsibility for building a program in his field.

Expressed opinions and observation of practice recorded in this study indicate that successful supervision by department heads in a subject-centered curriculum has been limited by lack of time, inadequate direction by administration, poor selection of candidates, lack of concept of the position, weak definition of the duties and responsibilities, and lack of training in leadership and techniques of supervision. Even though there appear to be many points of questionable performance the records indicate that in many schools the department head has been instrumental in bringing students to mastery of his subject with a view to preparation for continued training and study in the field.

Survey data and record of practice tend to support the claim that the subject-centered curriculum does not meet the needs of youth as they prepare to become citizens, parents, and wage earners.

The findings of this study manifest an increasing and positive movement toward the purpose-centered curriculum. It is an expressed preference for instruction which will prepare youth for life. It is based on a broad or major purpose-centered curriculum offering greater learning possibilities for the "whole child" and cares for his immediate needs as well as those of the future. The findings record, since 1910, a continued trend away from the departmentalized organizational structure with the department head in charge. There is supporting evidence that the department head organization does not foster a major purpose concept in the secondary school program.

Supervision, as conceived today, is a coordinating-helping procedure which does not need expert knowledge of each subject supervised. This change in supervisory need and the major purpose grouping of subjects tend to minimize subject and departmental lines. Practice has shown that the department head can serve well in this situation as a consultant in curriculum matters which demand expert information on subject matter.

Where major purpose group coordinators are employed, they tend to be generalists rather than specialists, and as such have no preferences in subject offerings other than the contribution a subject can make to the achievement of purpose. The full time curriculum and instruction specialist, with no assigned teaching, is more accessible to teachers for help than the department head.

Since a purpose-centered curriculum does not need the close inspectoral supervision of the subject specialist, the span of control has possibilities of being increased. The use of major purpose committees composed of teachers from all subject areas can provide a means of fostering the purpose-centered instructional pattern and a medium of curriculum direction and control in the comprehensive high school.

Recommendations

This investigation indicates that further study should be given to these phases of the position of the department head:

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

1. The relative costs of department head supervision as compared to improvement of instruction by means of subject area chairmen, purpose-centered chairmen, and/or curriculum coordinators.
2. A further look into special training applicable for those now carrying on the responsibilities of department heads with a view to broadening their activities in terms of the major purposes of secondary education.

Microfilm $3.10; Xerox $10.80. 238 pages.

LEGISLATION AFFECTING PUPIL TRANSPORTATION IN THE UNITED STATES

(Order No. Mic 60-6175)

John Geary Critchfield, Ph.D.
University of Pittsburgh, 1960

This dissertation has as its major purpose the comprehensive study of the provisions that have been made by the legislatures of all the States in the United States pertaining to the transportation of school children. It was undertaken to fulfill a need for a single, convenient source of information containing up-to-date statistics, details, and a comparative analysis of the legislation of all the States. There is no recent comparative study of school transportation available wherein one may find a summary of the legislation, a comparison of the enactments that prescribe means of transportation, an account of the changes in legislation necessitated by the vicissitudes of modern living and the rapid expanse of our educational program, or any suggestion for new or revised laws.

The basis of this study has been the legislation that has been passed by all the States from 1947 through 1959. This does not mean that school transportation is of such recent origin; in fact, the first such laws were enacted by Massachusetts in 1869. However, the bulk of legislation has increased proportionately with the increase in the use of motorized school buses and consolidated schools; and the scope of the present study must be delimited, for the optimum benefit, to the most recent legislation. The school laws of all the States have been studied intensively, and the variations in the transportation enactments have been analyzed; bulletins and circulars from various departments of education, doctoral dissertations, texts, and the findings and opinions of educational authorities have been used to supplement the study. Comparison has been made of the legislation of the individual states in reference to each phase of the transportation problem; trends, shifts in emphasis, and increasing uniformity of legislation form the basis for the conclusions and recommendations of this thesis.

Significant legislation has been enacted pertaining to pupil transportation. These laws cover such stipulations as: the minimum distances pupils must live from school to be eligible for free transportation, who may or must be transported, the use of school buses for extra-curricular activities, the standards for school bus construction and equipment, qualifications for school bus drivers, the coordination of state and local traffic laws for the protection of children getting on and off school buses, and the amount of state reimbursement to school districts for the cost of operations and maintenance of its vehicles and the loss due to depreciation. Besides these more common phases of the transportation problem, there is the question of liability insurance, which is already authorized by the enactments of forty-two states.

From the findings based on the intensive study of the state laws, it is recommended that the laws deal with the general aspects of pupil transportation, giving the power to duly authorized agencies or representatives to deal with local exigencies; that the state have complete authority over the bus routes regardless of existing boundaries; that all pupils living along the highway where traffic is heavy should be transported on the school bus regardless of the distance they reside from school; that all school buses be inspected more frequently and thoroughly; that a bus should be equipped with a first-aid kit and a two-way radio; that a bus driver should undergo a rigid training program and be highly qualified; that traffic laws regarding the passing of school buses should be uniform in all the states; and that the school laws of all the states should mandate that liability insurance be provided for all pupil transportation.

Microfilm $2.75; Xerox $9.45. 206 pages.

SURVEY OF FRESHMAN ORIENTATION PROGRAMS IN THE SIX PUBLICLY SUPPORTED UNIVERSITIES IN MICHIGAN AND INCLUDING A REVIEW OF THE DEVELOPMENT OF STUDENT PERSONNEL SERVICES IN AMERICAN HIGHER EDUCATION WITH EMPHASIS ON FRESHMAN ORIENTATION

(Order No. Mic 61-2327)

Nollie Belle Messer Daisher, Ed.D.
Wayne State University, 1960

Adviser: Mildred Peters

This dissertation is in the area of guidance, counseling, and student personnel work. It is a study of present practices in the freshman orientation programs of the six publicly supported universities in Michigan during the school year 1959-60. The study includes a review of the historical background of student personnel practices in American higher education with an emphasis on freshman orientation. The review contributes not only to the understanding of present practices, major problems, and emerging trends in these universities in Michigan, but also to an understanding of these practices, problems, and trends in their philosophical, sociological, and psychological setting in higher education within the total democratic framework of America.

The six universities in Michigan under study were:

Central Michigan University, Mount Pleasant.

Eastern Michigan University, Ypsilanti.

Michigan State University, East Lansing.

The University of Michigan, Ann Arbor.

Wayne State University, Detroit.

Western Michigan University, Kalamazoo.

The chief administrative officers of the freshman orientation programs in the universities studied supplied the data from files, records, publications, and other sources of their respective institutions. The data were supplied on a questionnaire directed to these chief administrators. The method of research employed in the study of orientation programs in the six universities was concerned with ascertaining present conditions, practices, and characteristics of the programs. In addition, information was sought concerning certain general aspects of the program and certain specific aspects of the program. The latter were concerned primarily with pre-college orientation of accepted freshmen, Freshman Week (or Days) orientation, and the continuing orientation program, including the freshman orientation course. In determining present practices, the study contributed to the extent that its findings can be used in formulating policies and working out plans for further development in the immediate future if administrators of freshman programs so desire.

This study of freshman orientation reveals that the six publicly supported universities in Michigan as of the school year 1959-60, and the summer immediately preceding it, are making efforts to continue to meet the needs of freshmen in spite of the impact of the beginnings of greatly increasing enrollments. Imaginative planning, greater utilization of personnel and facilities, and more creative approaches to problems of freshman orientation are in evidence in these six universities. Such evidences indicate that these institutions are responding to the present problems confronting them much as other leading universities of the nation are and as they have in the past when faced with problems whether similar or different.

However, limitations of personnel, facilities, and budget place serious deterrents to greatly needed expansion of present offerings and incorporation of others which are desirable into the programs for orientation of freshmen. Projections of still greater increases of enrollments, especially as the state universities absorb students transferring from the junior colleges and community colleges of the state make it imperative that personnel, facilities, and budget be found for these programs in order to adequately assist all new students, not just freshmen, in making successful adjustments to the universities and thus to insure a more satisfying college career and a greater contribution to the socio-economic life of the state of Michigan. Microfilm $6.10; Xerox $21.60. 478 pages.

AN EVALUATION OF THE ASSIGNMENTS AND LEVELS OF PUBLIC SCHOOL BUSINESS FUNCTIONS

(Order No. Mic 61-2529)

Daniel Russell Ellis, Ed.D.
University of Southern California, 1961

Chairman: Professor Nelson

This investigation analyzed and evaluated the business functions currently being performed at each of three administrative levels—state, county, and district—in the public schools of the state of California. The identification, classification, and legal assignment of business functions at state, county, and local levels were preliminary to the evaluation of these assignments in terms of sound principles of educational administration (1) as expressed by California school authorities in the report School Administration in California: A Pattern for the Future ("The Role Study") and (2) as judged by six separate panels of educational specialists selected to perform this task.

Five avenues of investigation were pursued: (1) a search of the literature and of California statutes, court rulings, and interpretations by government agencies; (2) identification and classification of the basic business functions performed for California public schools; (3) determination of the administrative level to which each function is legally assigned; (4) analysis of school business functions in terms of sound educational policy as recommended in The Role Study; and (5) evaluation of the assignments of business functions proposed in The Role Study by six panels of educational specalists qualified to render expert opinions on these matters.

Findings. (1) Among the three administrative levels, the state provides leadership at all levels, the county serves both in a liaison capacity between state and district and as a service office in verifying and approving many local business functions, and the local unit serves in an operational capacity. (2) A basic philosophy is emerging in the state that the burden of responsibility for school business functions be borne by the local unit. (3) Six panels of jurors were in close agreement that the proposals contained in The Role Study were sound and should form the basis for reorganizing the assignments of school business functions in California. (4) Such reorganization will entail some legislative changes which will affect all areas of school business management.

Conclusions. (1) The review of existing assignments of school business functions at the three administrative levels provides abundant evidence that legislative and constitutional enactments have provided adequately for efficient organization and administration of most of these functions. (2) A continuing program of re-evaluation of policy affecting these functions, procedures, and assignments of responsibility at state, county, and local levels is needed. (3) Basic to such a program of re-evaluation is a clear statement of educational philosophy within which the organizational pattern of the schools' business functions can operate. (4) While the vast majority of business functions were found to be assigned properly, a few were judged to be designated inappropriately: (a) less state and more local authority should be granted regarding stipulated ratios of expenditures for such areas as personnel, school construction, and purchase of supplies and equipment; (b) the county unit should not be involved in the publication of local budgets nor in the purchase of school buses, which is a dual state-district responsibility; and (c) there is some question as to the advisability of the local district carrying full responsibility for insurance coverage and for the processing of warrants.

Recommendations. (1) A restudy of all school business functions should be made regularly at ten-year intervals. (2) The state administrative level should continue to formulate over-all policies, especially as they relate to reporting procedures and forms and to the control of

credentialing requirements for certificated personnel. (3) Present statutes should be modified so as to enable all local districts, regardless of size, to purchase supplies according to uniform and legally standardized procedures. (4) In addition to its presently assigned business functions, the county unit should be given the responsibility of processing warrants for the local district. (5) Statutory changes are needed to allow the local school district to publish its budget and to purchase school buses from bond funds. Microfilm $5.55; Xerox $19.60. 434 pages.

AN ANALYSIS OF APPELLATE COURT DECISIONS DETERMINING THE AUTHORITY OF BOARDS OF EDUCATION AND THEIR AGENTS TO ESTABLISH RULES AND REGULATIONS GOVERNING THE CONDUCT OF PUPILS, 1900 TO 1960.

(Order No. Mic 61-1865)

Narciso Louis Gamberoni, Ed.D.
University of Pittsburgh, 1961

Supervisor: Richard W. DeRenner

This study analyzes the appellate court decisions occurring from 1900 to 1960 determining the authority of boards of education and their agents to establish rules that regulate the conduct of pupils. It involved a detailed study and analysis of seventy-six court cases listed in the American Digest System and the National Reporter System under "Schools and School Districts," Key Numbers 170, 171, 172, and 172 1/2. The case study or case brief method was used to determine the legal principles involved from the interpretations of the courts in the decisions.

Specifically, the purpose of the study was to:

(1) determine the powers vested in the boards of education, as shown by appellate court decisions, to make and/or delegate the authority to make rules and regulations governing the conduct of pupils;

(2) determine the trends in the discretionary authority of boards of education to make rules and regulations governing the conduct of pupils;

(3) ascertain those powers, vested in boards of education and/or their agents to establish rules governing pupil conduct, that have been upheld in two or more states by the respective appellate courts.

Some of the general conclusions were:

The discretionary powers vested in boards of education, as shown by appellate court decisions, to make and/or delegate the authority to make rules and regulations governing the conduct of pupils for the proper management and discipline of school affairs is very broad. Courts have been reluctant to substitute their own discretion for that of school authorities. They will not interfere except where authority is illegally or unreasonably exercised.

Rules and regulations of a school district, governing pupil conduct, are to be liberally construed when considering their construction and operation. The courts look to the validity and reasonableness of the rule. As long as school authorities act in good faith, actions which put into more permanent form previously adopted standards are not reviewable by another tribunal.

The number of litigations involving the authority of boards of education and/or their agents to make rules and regulations governing pupil conduct increased from 1900 through the 1940-1949 decade. Since that time, the number has been decreasing. During the past sixty years, the discretionary authority of school officials has, generally, been extended to include additional topics concerning the conduct of pupils.

Boards of education and/or their agents have certain powers that have been delegated to them by the legislative bodies in the several states. The delegated powers and the manner in which they have been delegated have varied from one state to another but there has come before the courts in the different states basically the same issues in certain topical areas involving rules and regulations governing pupil conduct. While a decision in any particular state declares the law for that state, it does not necessarily speak with conclusive authority in another state. Where a legislature or court finds no definitive pronouncement on the topic involved, they often cite cases decided in other states in support of the principles of law they uphold in specific litigation. From this procedure, the courts have been able to rule on similar topics that have been litigated in two or more states.

Microfilm $2.75; Xerox $7.80. 167 pages.

EVALUATION OF CURRICULUM DEVELOPMENT PRACTICES IN SELECTED SCHOOL SYSTEMS OF WAYNE COUNTY, MICHIGAN.

(Order No. Mic 61-2334)

James Luster Godbey, Ed.D.
Wayne State University, 1960

Adviser: W. Ray Smittle

The Problem

The purpose of this study was to determine the most promising practices in curriculum development in six school systems of Wayne County, Michigan. Staff members of the six school systems described their curriculum activities, indicated their estimate of the worth of the activities for teacher and student growth, and indicated teacher attitude toward the procedures used in curriculum study.

The problem was to survey curriculum development practices and in-service education programs of three school systems which had engaged in organized curriculum study and in-service education of teachers over a period of several years and three which had begun only recently in curriculum study and development of in-service programs.

Sources of Data

Data were secured from staff members of the six school systems through interviews with curriculum workers; through the use of questionnaires designed to describe the programs as they existed, including strengths

and weaknesses; through the value judgments of those who participated in curriculum activities as to their worth in teacher and student growth; and through analysis of test results over a period of years during the course of curriculum study. School systems surveyed ranged in student population from 8,000-23,000 and served families of varying socio-economic backgrounds.

The Methodology

Questionnaires were prepared for staff members to describe the curriculum development activities and to evaluate in-service programs for teachers in the school systems surveyed. The questionnaire developed for use in describing curriculum practices was completed by the person in charge of instruction for the school system.

The questionnaire dealing with the evaluation of in-service education in the school systems was completed by a random sample of teachers and principals who had participated in organized curriculum studies in each district. Personal interviews were held with each of the individuals who responded to the questionnaire concerning curriculum development procedures.

The Findings

1. Each of the six systems had a curriculum council or steering committee acting as a clearing house for programs affecting curriculum improvement.
2. Curriculum leaders, principals, and teachers expressed the need for greater cooperation and understanding between the different levels of instruction in the school systems.
3. All the school systems surveyed except one set aside an amount of money in their budgets for in-service education.
4. Staff members recognized the need for more opportunity for teacher participation in curriculum study.
5. Released time was provided for curriculum work to some extent.
6. Staff members indicated that they needed more consultant help in various areas of the instructional program.
7. The in-service education activities which teachers in the school systems surveyed felt were of greatest worth were ranked in the following order:
   a. Curriculum committee work.
   b. Building staff meetings.
   c. Subject area meetings.
   d. Grade-level meetings.
   e. Local workshops.
   f. Visits to other schools.
   g. Programs for orientation of new teachers.
   h. Use of local consultants.
   i. Pre-school conferences.
   j. Local curriculum planning courses.
   k. System-wide staff meetings.
   l. Summer conferences.
8. Poor communication was a deterrent to adequate reporting of results of curriculum study and implementing programs resulting from curriculum study.
9. The intelligence level of the students in all the school systems except one was in about the same range, but there were differences in the achievement levels of the students in the several districts.
10. The school systems which carried on a continuous program of curriculum study over a number of years reported the highest achievement among their students in every area of curriculum.
11. There were no outstanding changes in scores immediately after a curriculum study in a particular area of instruction, but constant interest and appraisal of the curriculum helped to improve or maintain high standards in all areas of the instructional program.
12. Little use was made of test results to improve the over-all instructional program in most of the school systems surveyed.

Microfilm $3.80; Xerox $13.50. 296 pages.

AN ANALYSIS OF AUTHORITY AND POWER IN ADMINISTRATION

(Order No. Mic 61-2113)

James Mortimer Hanlon, Ed.D.
The University of Buffalo, 1961

The purpose of this study was to analyze the authority-power dimension of administration. It was conducted in three parts. In Part One definitions were developed for the terms "authority" and "power," and their relationship was explained. In Part Two the current construct employed to describe the use of authority and power in administration was examined and a new construct was built in terms of administrator behavior. In Part Three this construct was tested for possible usefulness.

A review of the literature of administration showed that many writers found it difficult to deal adequately with the use of authority and power in administration. Furthermore, the definitions used by these writers differed significantly. Subsequent investigation in the fields of administration and political science revealed two distinct schools of thought as to the nature of authority and power and their relationship.

To test the validity of these schools of thought, Aristotelian logic was used, and the ontological notion of genus and species in particular. It was found that neither authority nor power was the genus term for the other, but that both were species of another term, "subordination." Metaphysical, proper, and causal definitions were established, and the relationship between the two was derived from their causal definitions.

The literature also revealed that the construct of "democratic-autocratic administration" was the currently-used description of the use of authority and power in administration. This construct was based on analogy, with the idea of "democracy" brought by that method from the field of political science into the field of administration. Most writers were clear in their praise of democratic administration and their condemnation of autocratic administration. A few writers, however, doubted the efficacy of democratic administration, and some even doubted that the analogy could stand the test of close critical scruitiny.

In Part Two of the study this analogy was tested. Using the definitions of authority and power established in Part One, a definition of democracy was developed showing three distinct relationships. Using business and education as fields for administration, the analogy was tested in terms of these three relationships. Although all the relationships held true for the fields of business and education, not one of them was found in administration in these fields. The analogy of "democratic administration" was therefore rejected as improbable.

To replace the democratic-autocratic construct a new construct was built in terms of administrator behavior in the authority-power dimension. Descriptions of behavior were drawn and a model was constructed in terms of the placement of authority and power, sanctions employed, and the arrangement of responsibility for the decision-making process. Three styles of behavior were established.

The construct was tested for possible usefulness in three ways. In a Critical Incident Study wherein teachers described effective and ineffective behaviors by their principals, a panel found all of the effective and 97.05% of the ineffective incidents classificable by the construct. In the second test the null-hypothesis of no difference in proportion was rejected at the .01 level of confidence, indicating usefulness of the construct as a tool in the study of administrative phenomena, particularly in the areas of principal-teacher relations, principal-other relations, and teacher-other relations. The final test found that the construct was a fruitful source of testable hypotheses when used in combination with other theories and constructs in administration.

Implications for further study in the area of authority and power are given in the study.

Microfilm $2.75; Xerox $4.40. 83 pages.

THE ORGANIZATION AND ADMINISTRATION OF CIVIL DEFENSE IN CALIFORNIA PUBLIC SCHOOLS

(Order No. Mic 61-2534)

Richard Hubert, Ed.D.
University of Southern California, 1961

Chairman: Professor Stoops

The purpose of this study was to determine whether the California public schools have the practices for civil defense organization and administration that have been recommended by the California State Department of Education and the California Disaster Office. The hypothesis was that school civil defense programs in 1960 were below the recommended standards.

The study was conducted by means of a questionnaire survey carried on in a group of 108 selected California public school districts that had been organized prior to January 1, 1950, and which had the same type of district organization on January 1, 1960. Seventy-eight of these districts contributed returns which were usable for this study.

Districts responded to questions regarding four areas of civil defense protective programs in the schools: (1) control and organization; (2) school plant, supplies, and equipment; (3) personnel administration; and (4) operations. Information was sought to determine (1) the importance districts attach to the recommended practices, (2) the recommended practices carried on by the districts, and (3) the reasons if districts did not have a recommended practice.

Data were considered for the group as a whole and for various subgroups within the entire group. The categories of districts used for comparison were (1) unified with elementary-secondary, (2) large with small, and (3) northern with southern.

Findings. Districts considered 37 per cent of the practices essential, 53 per cent desirable, and 10 per cent nonessential. Unified, large, and southern districts considered more practices essential when compared with elementary-secondary, small, and northern districts, respectively. Large districts, with 47 per cent, considered more practices essential than the other groups. Small districts, with 28 per cent, considered fewer practices essential than the other groups.

Districts carried on 36 per cent of the practices. Unified, large, and northern districts carried on more practices when compared with elementary-secondary, small, and southern districts, respectively. Large districts, with 50 per cent, carried on more practices than the other groups. Small districts, with 24 per cent, carried on fewer practices than the other groups.

Districts had the most practices in the area of personnel administration, with 55 per cent of these practices. They had the fewest practices in the area of school plant, supplies, and equipment, with 21 per cent of these practices.

Districts stated they did not have the recommended practices for the following reasons: (1) lack of interest, 46 per cent; (2) lack of information, 23 per cent; (3) lack of funds, 16 per cent; and (4) improper school function, 15 per cent.

Conclusions. (1) Civil defense programs in California public schools are below the recommended standards. (2) Districts have the civil defense practices which the districts consider necessary. (3) State leadership is necessary if school districts are to set up a civil defense program. (4) California has used the wrong approach to encourage school districts to set up a civil defense program.

Recommendations. (1) A study should be conducted to determine the progress California public schools are making toward establishing a curriculum for civil defense. (2) A study should be conducted of the organization and administration of civil defense in all California school districts. (3) California should set the minimum standards for school civil defense programs and require periodic reports of progress from all public school districts.

Microfilm $3.85; Xerox $13.50. 297 pages.

AN ANALYSIS OF THE FRINGE BENEFIT PROGRAMS OF SEVEN LARGE CORPORATIONS AND SEVEN LARGE CITY SCHOOL SYSTEMS

(Order No. Mic 61-2337)

William Harrison Kanzler, Ed.D.
Wayne State University, 1960

Adviser: W. Ray Smittle

The Problem

The author's ultimate purpose in the study was to attempt to discover some means of making a career in education more attractive to the present teachers of the nation's public schools and to the potential teachers in the future. The particular means investigated were those aspects of an employee's total compensation generally referred to as "fringe benefits." Salary schedules and the aesthetic compensations of an occupation were not considered.

The specific objectives of the study were: (1) to examine the fringe benefit programs of seven large commercial and industrial corporations, (2) to examine the fringe benefit programs of the public school systems of seven large cities, and (3) from the examination of the aforementioned programs to develop a comprehensive fringe benefit program that the board of education of a public school system might reasonably be expected to offer its professional employees.

Sources of Data

A list of seven corporations was drawn from the supplement to the July, 1957, issue of Fortune. The corporations were selected on the basis of their being the largest employers in seven basic fields of business. The corporations included were: the American Telephone and Telegraph Company (public utility), General Motors Corporation (manufacturing), Sears, Roebuck and Company (merchandising), Standard Oil Company of New Jersey (chemicals and petroleum), Pennsylvania Railroad Company (transportation), Metropolitan Life Insurance Company (insurance), and The First National City Bank of New York (banking).

From the Statistical Abstract of the United States and the U.S. Office of Education's Biennial Survey of Education in the United States a list was formulated of the public school systems of the nation's seven largest cities. The school systems included were: the New York Public School System, the Chicago Public Schools, the Los Angeles City School Districts, the School District of the City of Detroit, the School District of Philadelphia, the Baltimore Public Schools, and the Cleveland Public Schools.

The Methodology

A questionnaire was developed to aid in the critical appraisal of the fringe benefit programs of the fourteen organizations. The information was gathered by personal interviews and correspondence with at least one appropriate administrative officer in each organization.

The Findings

The plans of the school systems were superior to those of the corporations in the areas of sick leave provisions, sabbatical leave plans, and vacations and holidays.

The plans of the corporations were superior to those of the school systems in the following areas: life insurance; temporary disability insurance; total and permanent disability insurance; hospital, medical, and surgical expense insurance; separation allowances; bonus plans; profit sharing plans; stock purchase programs; payment of moving expenses; payment of expenses of job applicants coming for interviews; tuition payment plans; and employee discount plans.

There was no significant difference between the plans of the school systems and those of the corporations in the following areas: medical services, retirement plans, terminal pay plans, jury duty leave, leave for educational purposes, military service leave, reserve training duty leave, personal business leave, longevity pay plans, and scholarship plans.

Microfilm $4.40; Xerox $15.55. 344 pages.

ANALYSIS OF INSTITUTIONAL OBJECTIVES IN MICHIGAN COMMUNITY COLLEGES

(Order No. Mic 61-1177)

John Robert Kimball, Ed.D.
Michigan State University, 1960

Major Professor: Karl T. Hereford

It was the purpose of this study to conduct an analysis of the objectives of the community colleges of Michigan and to determine relationships existing between the perceptions of teachers and administrators of selected community colleges as to appropriate objectives. An analysis of community college bulletins and of the literature in the field led to the conclusion that the general, broad objectives for the community college could be defined in five areas. These were: (1) To provide programs of general education; (2) To provide college parallel and transfer credit courses; (3) To provide terminal programs; (4) To provide programs in adult education and community service; (5) To provide programs in guidance.

Operational hypotheses for the study were established in the null form from the following general hypothesis: "No significant differences will be found within or between administrative and teaching groups in the community colleges of Michigan as to their perceptions of objectives for the community college."

The methodology for testing the hypotheses consisted of three steps: (1) An analysis of the programs of all the community colleges in Michigan whose programs had been in operation for three years prior to 1959, in order to divide the colleges into two groups, those offering a comprehensive program in terms of the five defined objectives and those offering a limited program in terms of the objectives. (2) The administration of a questionnaire to five selected community college faculties, two from the colleges

with comprehensive programs and three from colleges with limited programs. This questionnaire purported to determine the perceptions of the community college administrators and teachers as to purposes for the community college as an institution. (3) Statistical analysis of the data to determine if significant differences existed between and within the groups studied.

Data were collected on 143 individuals from the five colleges surveyed. Hoyt's Test of Reliability was applied and it was determined that the instrument was reliable. The F test was applied to determine homogeniety of variance between the groups tested and the results were satisfactory at the 5% level. The Student's T test was used to determine the significance of differences between the responses of all the groups sampled. This test indicated that no general, significant differences existed within or between the groups.

Further analysis was conducted on questionnaire items where the mean of responses for the various groups was widely varied. Individual items were found to receive different types of response from administrators and teachers in some areas of the questionnaires. The analysis of the items also indicated some differences of perception between the two general types of college surveyed. A final analysis was conducted on responses concerned with perceptions of the completeness of the programs, perceptions of strongest and weakest programs, and perceptions of barriers to the achievement of comprehensive programs.

It was concluded from this study that while no general differences in response to the questionnaire could be attributed to institutional type or to the fact that the respondent was an administrator or teacher, differences in response to certain items were evident. The responses of the administrators tended to follow the pattern of established objectives for the community college more closely than did the responses of the teachers. Differences in responses between the two groups were also noted in the areas of admission standards for the community college and of general control. The study provided implications for curriculum development and for administration in the community colleges.

Microfilm $2.75; Xerox $6.20. 130 pages.

THE SAFETY EDUCATION PROGRAM OF THE PHILADELPHIA PUBLIC SCHOOLS — HISTORICAL BACKGROUND, DESCRIPTION, AND EVALUATION.

(Order No. Mic 61-2724)

Dalibor William Kralovec, Ed.D.
Temple University, 1961

The main purpose of this study was to describe and analyze the safety education program of the Philadelphia Public Schools. This involved four problems: 1. to trace the early development of safety education in the Philadelphia Public Schools; 2. to determine the present status of the program; 3. to develop an evaluation questionnaire for Philadelphia based on national, state, and local recommendations and standards; and 4. to evaluate according to the evaluation questionnaire the present status of the safety education program of the Philadelphia Public Schools.

This study dealt primarily with the instructional program of safety education in the Philadelphia Public Schools. Emphasis is placed on the organization and administrative phases of the program. Evaluation of the program is based on the evaluation questionnaire for Philadelphia developed in connection with this study from national, state, and local recommendations and standards.

The need for a study of the type projected here was evident from a review of previous research studies in safety education. These studies are primarily of a broad survey nature. The present study is designed to give a detailed analysis of the comprehensive safety education program of the Philadelphia Public Schools. It may be, in addition, a means of stimulation and inspiration to other communities in the organization and administration of vital and adequate safety education programs.

Chapter IV of this dissertation, "A History of Safety Education in the Philadelphia Public Schools from 1818 to 1960," was written almost exclusively from primary source materials.

The data for Chapter V, "General Aspects of Organization and Administration," Chapter VI, "Curriculum Development," and Chapter VII, "Distinctive Features of the Program," consisted, for the most part, of primary source materials from the files of the Division of Safety Education of the School District of Philadelphia. These materials included directives on organization and administration of the program, courses of study and guides, bulletins such as Administrative Bulletin No. 1, "Fire Safety in Schools," official communications to principals and others, correspondence, reports and summaries. These were arranged in a logical manner with appropriate documentation to give the story of the present status of the safety education program in the schools.

Chapter VIII deals with "The Evaluation Questionnaire for Philadelphia." This questionnaire was specifically developed for use in this study to serve as an evaluative instrument for the safety education program of the schools and as an administrative device to stimulate thought and activity in the field.

Chapter IX deals with Summary, Conclusions and Recommendations. The purpose of the summary was to present the most significant findings. The conclusions consisted of interpretations of the most important findings presented in the summary. Recommendations were offered for improvement of the safety education program of the Philadelphia Public Schools based on the findings of this study in terms of the possibility and desirability of constructive practical application to actual situations of at least some of the conclusions and in terms of the need for further research or study.

The Bibliography and Appendices conclude the dissertation. Microfilm $5.40; Xerox $19.15. 422 pages.

A COMPARATIVE ANALYSIS OF SELECTED GENERALIZED FORMULAS FOR THE DISTRIBUTION OF STATE AID FOR SCHOOL PLANTS IN MINNESOTA

(Order No. Mic 61-2148)

Robert Winslow Marker, Ph.D.
University of Minnesota, 1961

Co-advisers: Dr. Otto E. Domian
Dr. Clifford P. Hooker

The purpose of this study was to test, by comparison of dollar values, the amount of aid accruing to local school districts under varied types of distribution plans and varied local conditions. Plans used by the several states for distributing state grants for school plant purposes were analyzed. A series of twelve generalized formulas was developed to represent the essential differences among the state plans studied.

As a result of the study of state aid plans, three measures of task were identified and combined with varying degrees of equalization and flat grant distribution methods to create the twelve formulas. The three measures of task used were; 1) debt service expenditures, 2) capital outlay plus debt service expenditures, and 3) pupil units. In the order listed, the measures of task selected for formula use reacted as a type of continuum from a very specialized measure of school plant costs to a more general measure of educational task. Each of these measures of task was employed in a flat grant formula as well as in formulas representing high, medium, and low levels of direct equalization.

The twelve formulas were applied to a stratified random sample of school districts in Minnesota. All districts operating at least a twelve-year program in 1958-59 were classified in terms of financial ability, size of enrollment, and rate of growth. Three ability classes, three size classes, and two growth classes were established and sample districts were selected from each of eighteen groups of districts created by combining these three criteria.

The necessary data for each sample district were collected for each of five years, 1954-55 through 1958-59. The generalized formulas were then applied to these data to determine the amount of aid that would have been apportioned each district assuming the constant amount of one million dollars in state money to have been available in each of the five years.

Comparisons were made of the average annual amount of aid allotted each group of districts as well as the average annual amount of aid allotted per pupil unit to the groups as classified. Comparisons were made in terms of each of the eighteen groups of districts and also with all districts grouped solely by ability, size, or growth. Generalizations were made concerning the amount of aid apportioned each group of sample districts as classified in regard to the effect of the three different measures of task and the variations of equalization and flat grant formulas employed. Formulas were identified which favored the sample districts as grouped in each of the major classes: high, medium, and low-ability; large, medium, and small-size; and fast and slow-growth; as well as in each of the eighteen groups of districts created as combinations of these classifications.

Examples of the generalizations drawn were:

Debt service formulas favored districts of high-ability, large and small-size, and slow-growth.

Greatest equalization effect was observed under a pupil unit formula at a high level of equalization.

Fast-growth districts were allotted most aid under a debt service formula which also employed a high level of equalization. Microfilm $3.65; Xerox $12.85. 283 pages.

OBSERVABLE CHANGES IN SPECIAL SERVICES ASSOCIATED WITH UNIFICATION

(Order No. Mic 61-2536)

John Cooper Packard, Jr., Ed.D.
University of Southern California, 1961

Chairman: Professor Stoops

The purpose of the study was to record any observable changes in special services which were associated with unification. A structured personal interview was used to obtain data. The study was limited to unified districts which had been organized through county committees and on former high school district boundaries.

Findings. (1) The districts in this study provided more auxiliary services for their pupils after unification than the component districts had before. (2) Unification provided the opportunity for a district to plan for common practices in administering auxiliary services, thus providing greater continuity from kindergarten through the twelfth grade. (3) In order for a unified district to take full advantage of its potential ability to provide continuity and articulation, the district must have made positive efforts to plan in that direction. (4) Increased or expanded auxiliary services are caused more by planning than by unification. (5) Unification has been a major factor in bringing uniform policies and practices into the administration of auxiliary services. (6) Uniform policies and practices in administering auxiliary services have meant greater continuity throughout the school program. (7) Unification has not necessarily meant that more or less money was spent for auxiliary services. (8) A unified or consolidated type of transportation system appeared to be superior from a service, safety, and economy point of view. (9) The six unified school districts made better provision for repair work and servicing than did their component districts. (10) The six unified districts made greater effort to relieve school principals of transportation problems than did their component districts. (11) Superintendents reported there was more efficient transportation service in the six unified districts than in their component districts. (12) Unification, coupled with comprehensive planning and organization, should develop the ultimate in transportation safety, service, and economy. (13) More children were provided the opportunity of participating in a hot food program in the six unified districts than in their component districts. (14) More centralized storage facilities were available in the six unified districts than in their component districts; thus it was made easier for the unified districts to purchase in larger quantity at cheaper prices. (15) Improved food services

are caused more by planning than by unification. (16) Unification has been a major factor in bringing similar policies and practices into the administration of food services. (17) Uniform policies and practices in administering food services have meant greater continuity throughout the school program.

Conclusions. The only two direct observable effects of unification upon the special services were: (1) greater opportunity for efficiency of service was possible, and (2) greater continuity in special services was provided between elementary and secondary schools. Efficiency of service did not come automatically with unification, but the opportunity for it did. Greater continuity between elementary and secondary programs was not absolutely guaranteed, but it appeared that it would take negative action on the part of the governing board or staff to avoid it.

Recommendations. (1) If the people within a high school district cannot reach agreement on unification of their schools, some attempt should be made to consolidate the elementary and secondary special services. Transportation services should benefit from consolidation, if operated by the high school district. Health councils would appear feasible under consolidation. Centralized storage facilities for commodities used in the cafeterias should also be consolidated. (2) Further research should be done in observable changes in phases of the school program other than special services as they are associated with unification. It might also be advisable in such a study to include districts which had been organized on elementary boundaries rather than on secondary boundaries. Microfilm $2.75; Xerox $8.60. 187 pages.

CHANGING FUNCTIONS OF THE COUNTY SUPERINTENDENCY IN PENNSYLVANIA SCHOOLS

(Order No. Mic 61-2399)

Lloyd Wharton Showers, Ed.D.
The Pennsylvania State University, 1961

The basic problem in this study is: Are the duties and functions of the county office more important now than they were in 1950, and will they be as important in the next decade as they were in 1950?

Data were secured from three sources:

1. A study of the history of the office of county superintendent in Pennsylvania and a review of the literature.
2. Personal interviews with nine present and former members of the Department of Public Instruction.
3. Questionnaires completed by thirty-two of the thirty-seven county superintendents who were serving as superintendents or assistant superintendents in 1950.

The findings reveal that:

1. When high calibre men with outstanding leadership ability have served as county superintendents the cause of education has been advanced.
2. To be effective the county office must provide services which local districts cannot or are unable to provide for themselves.
3. Both Department of Public Instruction personnel interviewed and county superintendents who responded to the questionnaire were of the opinion that most duties of the county office in the following areas are at least as important or more important in 1960 than they were in 1950 and are expected to be at least as important in 1970 as they were in 1950: Administrative duties, Supervisory duties, School Board activities, Auxiliary area duties, In-service Education programs, and Public Relations duties. Both types of respondents, Department of Public Instruction personnel and county superintendents, agree that the future role of the county superintendent's office will be more important especially in administrative and supervisory activities.
4. Based on their opinions, the average of the replies of Department of Public Instruction personnel to 58 statements used in the interviews reveal:

   (a) Replies to 19 of the above statements show that county office activities are as important in 1960 as they were in 1950, 37 statements show that the activities are more important in 1960 than they were in 1950, and 2 statements show that the activities are less important in 1960 than they were for 1950.

   (b) Replies to 15 of the 58 statements show that county office activities will be as important in 1970 as they were in 1950, 41 statements show that the activities will be more important in 1970 than they were in 1950, and 2 statements show that the activities will be less important in 1970 than they were in 1950.

5. Based on the responses of the 32 county superintendents to 73 statements used in the questionnaire, the average of their replies reveal:

   (a) Two of the 73 statements indicated that the activities are as important in 1960 as they were in 1950, 59 statements show that the activities are more important and 12 statements show that the activities are less important in 1960 than they were in 1950.

   (b) Sixty of the 73 statements show that the activities are expected to be more important in 1970 than they were in 1950, and 13 show that the activities are expected to be less important in 1970 than they were in 1950. .

Recommendations include:

1. The Commonwealth of Pennsylvania should accept increased responsibility for the staffing of county offices with specialists to provide services which cannot be provided economically at the local level.
2. The duties and responsibilities of the office of the "County Superintendent of Schools" should be redefined by the General Assembly in terms of its present activities and future possibilities.

Microfilm $3.80; Xerox $13.30. 293 pages.

EDUCATION, ADULT

A COMPARATIVE STUDY OF SOME INTERESTS AND ATTITUDES RELATIVE TO PUBLIC SCHOOL ADULT EDUCATION

(Order No. Mic 61-1940)

Gordon Bernard Wasinger, Ph.D.
State University of Iowa, 1961

Chairman: Dr. J. L. Davies

The study was an investigation of the value of verbal interest expression sources relative to adult education program development and the value that some attitudes may have as factors influencing participation in adult education programs.

Answers were sought for these questions:

1. Do significant differences of verbal expression of educational interests exist between adult school participants and those that do not participate?
2. Do significant verbal response differences on selected attitudes exist between adult school participants and nonparticipants?
3. Do significant differences of educational interest expression or attitude response exist from community to community?

An instrument was developed for the structured interview. For purposes of this investigation it was considered desirable to obtain interest responses to general subject matter areas rather than course titles. Ten general subject matter areas were developed. The first section of instrument was developed for responses made independently to the ten areas. The second section was developed to obtain rank order responses to ten areas.

Six general attitude statements were developed for section three with related personal questions. Section four was designed to obtain personal information on each interviewee.

Five Iowa communities--Waterloo, Fort Dodge, Saydel School District, Perry, and Sheldon--were selected as representative in size and geographic location. A random sample of adults was selected from last completed session of evening school. People that attended provided names for sample of adults that did not attend.

The instrument was completed during personal interviews in homes and places of business. The interviews were scheduled by administrative staff of the local school district. A total of 388 people were interviewed.

Responses were converted to numerical values and tabulated on frequency distributions. Means and rank order relationships were established. Comparisons of responses between community groups, among intercommunity groups, and between combined groups were presented. Tests using "t" and "z" statistics were conducted. Comparative analyses of responses by groupings of age, education, occupation and income were developed.

The following conclusions are presented:

1. In response to the first question posed: Do significant differences of verbal expression of educational interests exist between adult school participants and those who do not participate; the answer is "no" within the limitations of this study.
2. In response to the second and third questions posed, the same answer applies.
3. Based on the results of the combined nonparticipant responses it appears that the subject areas of Family Relations, Community Development and Religious Understanding hold promise for attracting nonparticipants to adult education programs.
4. The personal comments related to the verbal interest responses provide reason to consider the point that discussion type responses might furnish meaningful information for adult education.
5. The difference in responses between the general attitude statements and the related personal questions provides reason to consider the need for personally oriented investigation of attitudes.
6. The composite response of nonparticipants indicates that this group is more conscious of time pressures.
7. Group analysis by age, education, occupation, and income provides valuable data for the adult educator to use in program planning.

Some recommendations are presented:

1. This study did not attempt to clarify the motivational role of interests for adult education. It is recommended that this is a needed area for adult education and should be identified for investigative activity.
2. That a study be made of the relative value of the various types of interest responses.
3. That attitude analysis, as potentially influencing participation, be continued and that study should be based on more personal responses than used in this investigation.

Microfilm $5.95; Xerox $21.20. 467 pages.

EDUCATION, HISTORY

THE CONTRIBUTIONS OF HORACE MANN, MARY PEABODY MANN, AND ELIZABETH PEABODY TO ART EDUCATION IN THE UNITED STATES.

(Order No. Mic 61-2397)

Robert James Saunders, Ed.D.
The Pennsylvania State University, 1961

This study is an investigation into the contributions of Horace Mann, Mary Peabody Mann, and Elizabeth Peabody to art education during its period of introduction into the public schools of the United States, through the Boston of the nineteenth century. It uncovers new evidence on previously contradictory statements in the art education histories of Clarke, Haney, and Logan. The letters, and published and unpublished writings of Mann and the Peabodys were consulted. The study takes the form of a review of these writings, and interprets the art educational philosophies expressed in them.

The thesis begins by tracing the historical background of art education in the United States back to the Sense Realism of Rabelais, Montaigne, Locke, Comenius, and Petty, discusses the growth of art out of a colonial and Calvinistic New England, through the American Revolution to the succeeding nationalistic trend in the fine arts. It also shows the social, cultural, and industrial framework within which art found itself placed in the educational program of Boston.

The study on Horace Mann begins with a discussion of his rural background, and examples of drawings and lettering as an adolescent. It discusses his purpose in favoring

a practical and mechanical drawing program, instead of one in the fine arts, reviews his European tour, his "Seventh Annual Report," and his contributions as editor of the Common School Journal. The author suggests that Mann's aesthetic interests were overshadowed by his humanitarianism, resulting from his rural and somewhat Calvinistic upbringing. His realization of the need for practical education to support an industrial economy caused him to consider the fine arts as an "indulgence in superfluities."

The study on Mary Peabody Mann discusses the possible influence of art in an urban and commercial center, Salem, and her parents who were both, at times, teachers upon her childhood. It discusses her methods of teaching drawing in 1841, and introduces almost conclusive proof that she translated Schmid's Guide to Drawing from the German. The author suggests that she was more of a practical teacher, and less of an intellectual theoriest, than her sister Elizabeth, and that her appreciation of the Fine Arts was more aesthetic than that of her husband, Horace Mann, because her background was more cosmopolitan.

The study of Elizabeth Peabody discusses her intellectual proclivities, and her moral and religious approach to society and education. It investigates the influences of the Edgeworths, Graeter, Allston, Rev. Channing, and Froebel on her art education philosophy, and the development of her insistence that true art have a moral and spiritual value. Her methods of teaching drawing, and her purposes in using art for teaching children to see and understand the "devine order" in nature are discussed through reviews of her writings, Record of a School, "A Dorian Measure, . . . ", and Kindergarten Guide. The latter developed from her introduction to Froebilian philosophy, and in this she integrates her own transcendental point-of-view of creativity with his teaching methodology. Her concept of imagination as an energy to be guided toward spiritual good is reviewed in her critique of Hawthorne's Marble Faun. Her contribution through publishing A Method in Teaching Linear Drawing is reviewed and the author suggests this to be the work of a Mrs. William Minot.

Of these three protagonists, Elizabeth was the most prolific in her contributions to art education, and the majority of the thesis consists of a discussion of her work, and her thought concerning the spiritual and religious aspects of creativity and art.

Microfilm $3.20; Xerox $11.05. 245 pages.

A HISTORICAL STUDY OF EDUCATION IN MILTON, PENNSYLVANIA.

(Order No. Mic 61-2409)

Jack Eugene Williams, Ed.D.
The Pennsylvania State University, 1961

This study was designed to collect, evaluate, and preserve the available data on the development of education in Milton. The initial chapter of the study was limited to those private schools for which there were available records. These were examined in an effort to record their inception, growth, and decline. The second part of the study encompassed the public schools of Milton and was focused upon the administrative tenure of three individuals: (1) Superintendent Reist Rutt, (2) Superintendent Carl Millward, and (3) Superintendent Albert C. W. Schlegel. The personality of these administrators played an important part in the growth and development of the public schools during their particular periods of influence. Because no outstanding administrative personality appeared until the closing years of the nineteenth century, the initial chapter on the public schools of Milton was focused upon important events of the period rather than upon the personality of an individual.

Data for this study were secured from the following sources: (1) Miltonian, (2) Milton Evening Standard, (3) Deed Books of Northumberland County, (4) Minutes of Milton School Board, (5) Minutes of Milton Area Joint School Board, and (6) personal papers of Frederick Godcharles.

In collecting the data for the study, the author formulated some general impressions which reflected local sentiment. Some of the description found in the study has evolved from these impressions and not from quotable sources.

This study has revealed the following trends in public education in Milton: (1) a shift of influence and control from the local district to the state government, (2) a broadening of the curricular offerings of the school system so as to meet the ever changing needs of the pupils, (3) a gradual expansion of the public educational system which has resulted in its becoming one of the most important businesses of the community, and (4) a shift of administrative control from the lay members of the school board to the professional educator who specialized in school administration.

The public school system of Milton was created under the provisions of the "Free School Act of 1834." This act, which was permissive in nature, placed the major responsibility for the operation of the public school system in the hands of the local school district. For approximately twenty years the state exerted almost no influence or control over the public educational system. The "Act of 1854" took some of the responsibility away from the local district and placed it in the hands of the newly created county superintendent. Since 1854 there has been a gradual shift of authority from the local district to the state government. This loss of local control was especially evident in the latter part of this study.

The curricular offerings of the first public schools of Milton provided a basic elementary education which consisted of instruction in reading, writing, arithmetic, and sewing. The passage of time produced changes in the educational needs of the children of the community. These needs were met by a gradual expansion of the school curriculum. From this expansion has evolved the present curriculum which provides the children of Milton with courses which are of a general, vocational, commercial, and academic nature.

The first school term of the public schools of Milton was conducted with a total expense of $797. The 305 children who attended these first schools were taught by seven teachers. From this meager beginning has evolved an educational system which has increased greatly in its school enrollment, physical assets, and employed personnel, with the result that it has become one of the largest and most important businesses of the community.

The growth in the public school system resulted in a shift in its administrative control. As long as the school system was small the school board members were able to assume the administrative responsibility, but as the school expanded this administrative responsibility was gradually shifted from these lay educators to the professional educator who was a specialist in school administration.

Microfilm $3.75; Xerox $13.30. 291 pages.

EDUCATION, PHYSICAL

AN EVALUATION OF SELECTED PHYSICAL EDUCATION ACTIVITIES FOR COLLEGE WOMEN: A COMPARATIVE ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES TO DETERMINE THEIR EDUCATIONAL POTENTIALS.

(Order No. Mic 60-3757)

Marion Elizabeth Rogers, Ph.D.
New York University, 1960

The Problem and Its Importance

This study is concerned with evaluation of selected activities in the college physical education program for women. It particularly is concerned with determining their educational potentials.

The establishment of educational potentials long has been acknowledged by authorities as one of the most pressing needs in the field. Now the inherent values are determined on a scientifically valid basis. The values have direct implications for program planning, student guidance, improvement of program construction, and can serve as guideposts for facilities planning, and preparation of professional leaders in physical education.

The Historical Background of the Study

Except for one very extended study sponsored by the Committee on Curriculum Research of the College Physical Education Association,[1] very little material has been found relating directly to this research. The LaPorte study was a valuable frame of reference, however, for development of this investigation. Much material is written about different aspects of the physical education program, including content, values to be derived from participation, and student needs and interests. None located, however, was concerned with establishment and validation of criteria for evaluation of activities.

Procedures Used in Collecting Data

Scientific facts relating to Development, Adjustment and Leadership characteristics and needs of college women were derived from analysis of the materials in anthropology, sociology, education, psychology, physical education and biology.

Activities evaluated, were selected in terms of the following three criteria: (1) acceptance and/or presentation currently in the college program; (2) classification, indicated by similarity of organization, tactical elements, equipment and facilities; and (3) demands made on participants.

Criteria for evaluation of activities were derived from analysis of the characteristics and needs of college women, established through survey of the literature on growth and development. The criteria were validated through review and analysis of the literature in anthropology, sociology, education, psychology, biology and physical education.

Evaluations were obtained by means of comparative analyses in which selected jurors applied established and valid criteria to the activities, in terms of a ten point scale adapted from one utilized by Thurstone and Chave[2] for measurement of attitudes and opinions.

Principles for adaptation of activities were drawn (1) from review and analysis of the research findings pertaining to growth and development needs and characteristics of college girls, and (2) from the facts ascertained from the scientific literature cited above.

The Results

For the fifty-five selected activities relative potential worth for Development, Adjustment, and Leadership has been established. Twenty of the fifty-five score "High" in both All-Round potential educational value, and in Total Development value; twenty-six are "High" in Total Adjustment contribution; and sixteen in Total Leadership value.

Forty-six principles are derived for adapting the activities in the college program for physical education.

Conclusions and Recommendations

Physical education activities have educational potentials that have been established in this study.

College students have needs general to their age group. Participation in selected and evaluated activities can contribute to satisfaction of those needs.

Because activities characteristically vary both in amount and kind of educational potential, offerings in the college program should include those from different classifications.

College administrators are responsible for providing leadership, facilities and time in the college program for physical education to contribute as it can to education for Development, Adjustment and Leadership.

Future research can well look into the quality of leadership, time allotment, and program offerings in college physical education.

1. W. R. LaPorte, "Committee on Curriculum Research," Research Quarterly, 22 (March, 1933), p. 146.
2. T. L. Thurstone and E. C. Chave, The Measurement of Attitude, p. xi.

Microfilm $6.65; Xerox $23.65. 524 pages.

AN EVALUATION OF A TEACHER EDUCATION PROGRAM IN HEALTH AND PHYSICAL EDUCATION

(Order No. Mic 61-1131)

Luther Clarence Schwich, Ph.D.
University of Utah, 1961

Chairman: Dr. N. P. Neilson

THE PROBLEM

The problem was to evaluate the teacher education program in health and physical education at Concordia Teachers College, Seward, Nebraska. The ultimate purpose was to improve the programs in Lutheran elementary schools.

PROCEDURES

An analysis was made of the literature for available lists of health and physical education functions of teachers.

Five lists were discovered, compared, and synthesized into one list containing one hundred thirty-six functions. These functions were included in a check list that was used to procure data. Graduates of Concordia contributed their judgments concerning: (1) the desirability of the check list items as teacher functions, (2) the use or applicability of the functions in their programs, and (3) a rating of their performance in the functions. Faculty members at Concordia responded concerning the desirability of the functions and their applicability to courses at Concordia. Data analysis disclosed strengths and weaknesses in the present program.

TYPES AND SOURCES OF DATA

One type of data was obtained from an examination of the literature. These data were used primarily in the development of the check list. A second type of data was derived from the analysis of teachers' responses. A third type included information obtained from faculty members and from documents on file at Concordia. These data were used to determine the scope of the present program.

FINDINGS

Elementary school teachers and college faculty members agreed on the desirability of the functions. They disagreed slightly as to the desirability of particular functions. Teachers did not judge the functions as highly when rating applicability as when rating desirability. General functions are highly applicable to the existing program and courses. Some functions were taught only in the required physical education courses, and other specific functions were included only in the minor program. Graduate teachers rated higher on performance than non-graduate teachers. Physical education minors rated higher than all other teachers.

CONCLUSIONS

The following conclusions were drawn:

1. Teachers did not perform the functions to the same degree they attested to their desirability. Perhaps this was true because: (a) programs were not developed sufficiently, (b) teachers did not judge themselves competent in performance, and (c) they did not think some functions were desirable.
2. The teacher education program helped students acquire competency in general functions, but the health and physical education requirement was the only means of acquiring many of the specific competencies.
3. While the present required program in health and physical education helped teachers acquire some competency, the program was not adequate to help all teachers attain the level of competency recommended by the literature.
4. The physical education minor should be designed to help students attain a higher level of competency from that sought for all teachers through the required program.

RECOMMENDATIONS

The following modifications in the present program were recommended:

1. Basic requirements in health and physical education should be increased from four semester hours to seven semester hours.
2. The requirments should include five hours of general education courses and two hours of professional education courses.
3. General education requirements should be divided into two one hour physical education courses, and a three hour personal and community health course.
4. The two hour professional requirement should be designed to help students acquire the optimum level of competency in those functions included in this study.

Microfilm $2.75; Xerox $8.00. 175 pages.

THE DEVELOPMENT OF PROFESSIONAL EDUCATION PRINCIPLES FOR PHYSICAL EDUCATION COLLEGES IN INDIA

(Order No. Mic 61-350)

Harbans Singh, Ph.D.
New York University, 1960

Chairman: Professor Morey R. Fields

The Problem

It is the purpose of this investigation to formulate principles of professional education for physical education colleges in India.

Need for the Study

The present curriculum of teacher preparation in all colleges of physical education in India has not been developed on sound scientific procedures. Therefore, there is an extreme need to formulate principles which may serve the purpose of giving sound foundation to the professional curriculum.

Procedures

The investigator conducted a philosophic type of research dealing with values and principles of professional education. To start with, the researcher studied the numerous cultural factors which influence teacher education in India. Existing Indian professional education principles were described in order to develop professional education principles for physical education colleges. The implication of cultural factors and the existing teacher education principles were described so as to guide the professional preparation in physical education. In order to give a broad basis to the professional curriculum in physical education in India, the researcher described the latest teacher education principles in the United States. Some of the United States professional educational principles have been adopted or modified to make it compatible with Indian culture and the Indian educational philosophy.

Results

The following are the important professional education principles developed by the investigator which were philosophically sound and conclusive:

1. Teacher education curriculum should provide a broad general education in order to help the students to appreciate and understand cultural heritage.
2. Teachers should understand the objectives of education. They should know the goals of the institution.
3. The teacher education plan should be derived from a synthesis of cultural elements of Indian and Western educational philosophy.
4. Traditional Indian philosophy emphasizes spiritual emancipation. It should be oriented to new needs and interest to prepare teachers fully in this "space age."
5. Teacher education should recognize, and accept the great diversity of physical features in India.
6. Indian education, in order to be effective, must be rooted in everyday life experiences.
7. The professional education curriculum should assist prospective teachers in understanding the principles of the psychology of learning.
8. The organization and administrative set-up of professional curriculum should be democratic.
9. The best educational procedures in use in all phases of teaching should be adapted to the teaching of physical education.
10. A candidate should have attained an acceptable intellectual maturity and should have completed the entrance requirements to the Professional school.
11. Adequate facilities should be provided in professional education institutions to give optimum learning experience.
12. Professional education curriculum in physical education should aim at developing competent and qualified teachers with adequate professional knowledge and skills for teaching physical education in India.

Suggestions and Recommendations

The researcher recommended to put into practice the professional education principles developed by the investigator. It was suggested that a national board of curriculum experts be set up which can coordinate and evaluate the curriculum for professional preparation in physical education on a continuous basis.

In addition to the usual course requirements in professional education, the investigator recommended to include courses in Public Relations in Physical Education, Tests and Measurements, Guidance and Counseling, Community Organization, and Logic.

It was suggested that further research should be conducted to evaluate the existing curriculum in the light of the principles developed by the investigator.

Microfilm $3.20; Xerox $11.25. 246 pages.

EDUCATION, PSYCHOLOGY

FACTORS IN MOTIVATION TO WORK ACROSS THREE OCCUPATIONAL LEVELS

(Order No. Mic 61-1133)

Frederic John Anderson, Ph.D.
University of Utah, 1961

Chairman: Reed S. Merrill

The problem in this study was two-fold. First, it was an attempt to determine whether the findings, with respect to factors in motivation to work, of a study by Herzberg, Mausner, and Snyderman in which the sample was a group of engineers and accountants were applicable to other professional groups and second, to determine whether these findings may be justifiably applied to groups from differing occupational levels. The major conclusion of Herzberg et al. was that the basic factors leading to job satisfaction are actual-job factors, factors involved in the actual doing of the job, while the factors more likely to act to produce job dissatisfaction are job-context factors, factors related to the context in which the job is done.

The total sample of the present study consisted of workers from three occupational levels at a Veterans Administration General Medical and Surgical Hospital. The sub-samples were a group of 35 laborers and food service workers, 31 tradesmen, and 39 nurses which are representative of the unskilled, skilled, and professional occupational levels.

The data unit of the study was the sequence of events which was obtained through a semi-structured interview. The worker was asked to tell about periods of time in which his feelings about his job were exceptionally good and exceptionally bad. These high and low sequences were then coded and analyzed in terms of the categorical scheme developed by Herzberg et al. through the method of content analysis. Each of the sequences was coded in terms of type of sequence, first-level factors, second-level factors, and effects. First-level factors are the categorizations of the objective events in the sequences, such as recognition; second-level factors are the categorizations of the workers' feeling level perception of the occurrences, such as feelings of achievement resulting from the presence of a first-level factor.

The findings of this study are essentially in agreement with those of Herzberg et al. in that the complex of factors relating to the actual work are more likely to increase job satisfaction than they are to serve as dissatisfiers. This is particularly true for the professional group for which each of the five self-actualizing first-level factors, recognition, advancement, achievement, responsibility, and work itself, appeared in the greater percentage of sequences acting to increase satisfaction as compared with those decreasing job satisfaction. The actual-job factors, achievement and recognition, also played an essentially unidirectional role for the unskilled and skilled samples while the other factors did not do so.

Only one job-context factor, interpersonal relations-superior, played an important role in the determining of job satisfaction for the three occupational samples. In general, the job context factors were found to be basically unidirectional and functioned as dissatisfiers.

The second-level factors, feelings, most often associated with satisfaction for all occupational levels are recognition, achievement, advancement, responsibility, group feeling, and pride while those most important in producing only dissatisfaction are possible growth, insecurity, and unfairness.

It can be stated that the findings of this study do substantiate the conclusion of Herzberg et al. that those factors in the work life of professional workers which may be termed satisfiers are a complex of factors concerned with the actual doing of the job, growth or self-actualizing factors. These factors relatively seldom function as dissatisfiers. The results of the study also support the conclusion that job-context or job situation factors primarily function as dissatisfiers and rarely as satisfiers.

It is further concluded that these findings with respect to professional workers also hold up for workers at the skilled and unskilled levels, but with reservations. Those factors which represent aspects of the situation or job context do function primarily as dissatisfiers while the actual-job factors are either primarily satisfiers or are of equal importance as both satisfiers and dissatisfiers.

Microfilm $2.75; Xerox $6.40. 134 pages.

THE MULTIPLE-MEANING SYNONYM VOCABULARY TEST FOR CHILDREN OF ELEMENTARY SCHOOL AGE

(Order No. Mic 61-2347)

Anthony Alfred Angeloni, Ed.D.
The Pennsylvania State University, 1961

Statement of the Problem

The primary purpose of the study was an empirical investigation of the multiple-meaning synonym vocabulary test, linear type item, with children of elementary school age and the test's value as a new form for vocabulary evaluation.

Brief Procedures

The words of the Scott-Foresman New Basal Reading Series that were in Webster's Dictionary of Synonyms were retained as the basic file. The words were given the G count level of difficulty from the Thorndike-Lorge Word Count. The words of appropriate grade level difficulty were retained. All synonyms in the synonym dictionary were written under the chosen base words and the G count number of the synonyms was listed. Questions were formulated using only the synonyms of appropriate difficulty level and randomly placing the synonyms in the question. Decoy words were chosen of appropriate difficulty level to complete the question. The questions were randomly arranged in the tests per grade level and variation of questions was made in order to have an adequate range of from one to five response items per grade. The initial test, retest, and achievement tests were given and scored. Analysis was made of the results.

Conclusions

Conclusions drawn from the data apply to the children in the study and the results of the testing of these children.

1. Highly valid and reliable tests with a small standard error of measurement were secured. Validity relationships explored were between the multiple-meaning synonym vocabulary test, linear type item, and the Metropolitan Achievement Test, Form B, 1959 Edition, word knowledge and reading comprehension subtests. Validity correlations ranged from .62 to .86. Reliability correlations, using the test-retest method, ranged from .82 to .96. The best scoring system was the total-items-correct method. The total item was correct when only the correct synonyms were marked with no decoy words marked in the question. For the total items score, the standard error of measurement ranged from plus or minus two to four items.

2. The findings of the study agree with previous studies of the value of the synonym vocabulary test in determining higher intelligence through the high variability of correct synonym responses known by the individual. The results agree with previous studies of the value of the multiple-meaning test. More words have been tested in approximately the same time and the same space as a single meaning vocabulary test. A more substantial inventory of pupil's knowledge of words which have more than one meaning was secured. Because five responses at varying difficulty levels could be used in one question, the single question tested the range of vocabulary thus replacing five single-answer type questions needed to secure range in present tests. More questions and responses could thus be used in a test.

3. The question format of the multiple-meaning synonym vocabulary test, linear type item, has an inherent psychological effect of success in each question. Since various difficulty levels are used in each question, the test taker usually recognizes some of the responses and can answer them successfully. The answering of these individual responses will not significantly raise his total items score. Since he does know some answers, the test taker is not frustrated by continually meeting unknown words, a factor usually present in the tests that move from easy to difficult in a series of questions.

4. The evidence of the study suggests that the multiple-meaning synonym vocabulary test, linear type item, does probe depth of meaning, variability of individuals, and richness and extensiveness of vocabulary better than present single-answer type tests. The evidence indicates that the test has value as a new form for vocabulary testing of children of elementary school age. The findings indicate that more research is needed in the area of multiple-meaning vocabulary tests at all educational levels. The multiple-meaning vocabulary tests show possibilities of giving more and better information than present single answer type tests. A large amount of information may be secured with economy of time and space.

Microfilm $2.75; Xerox $4.60. 89 pages.

SOME PERSONALITY AND TEMPERAMENT CHARACTERISTICS OF SELECTED SCHOOL MUSIC TEACHERS

(Order No. Mic 61-2521)

George William Barth, Ed.D.
University of Southern California, 1961

Chairman: Professor Rush

Determining the personal qualities essential for teaching effectiveness is a persistent problem in teacher education.

This investigation was undertaken in search of more objective bases for the guidance, selection, and admission of candidates to music education curricula. The purpose of the study was to find relationships of personality and temperament characteristics, as measured by twenty-three test variables, to school music teacher effectiveness, as established by nomination for membership among the "top ten per cent" of school music teachers.

Three hundred sixteen school music teachers, in two contrasting groups, were studied; their participation was voluntary. There were four samples (156 teachers) of selected instrumental music and choral-general music teachers and three general samples (160 teachers) of other certificated school music teachers in the same teaching fields. Twenty-two music education specialists, approved by the committee on studies, nominated the selected teachers.

Cattell's Sixteen Personality Factor Questionnaire and the Thurstone Temperament Schedule were employed to provide anonymous raw score measurement data upon the personality source trait and temperament characteristics of the teachers.

Findings. The seven teacher samples, when compared upon normative statistics in terms of mean scores, occupied the same general area on twenty-two factor dimensions. Only on Factor B, Cattell's measure of general mental ability, was clear differentiation found between selected and general teacher samples. The selected sample mean scores (9.5 to 9.9) were grouped above the adult standardization population mean (9.2) and the general sample mean scores (9.0 to 9.1) were grouped below; the seven teacher sample mean score ranges overlapped on the other twenty-two factor dimensions.

When the level of probability associated with the significance test of the difference between sample means was found for each of the twenty-one teacher sample pairings on a factor, 111 significant differences between sample means at or beyond the .05 and .01 levels of confidence were found. No pattern of differentiation emerged; differences found were between (1) selected samples, (2) general samples, and (3) selected and general samples.

When the four selected samples and the three general samples of teachers had been pooled separately and sorted according to expressed satisfaction with the school music teacher vocation, both the normative and correlational statistical analyses procedures employed indicated the ninety-three selected teachers who had expressed the highest degree of satisfaction with their work differed on certain Cattell and Thurstone test factors from the ninety-five general sample teachers who expressed lesser degrees of satisfaction. The selected teachers were found significantly higher than the other group, on the average, in general mental ability and in perseverance and persistence; they were more self-sufficient, more accepting, outgoing, understanding, and permissive, more confident and self-secure, less tense and anxious, more active, possessed more leadership qualities, and were more emotionally stable.

Caution must be exercised in interpreting these statistical findings; group measurements were employed and the interpretations given were in terms of group averages.

Recommendations. Recommendations growing from the study were (1) that the findings of this investigation should be tested empirically through longitudinal studies of students now in music education curricula and later in their teaching positions, (2) that the test items should be subjected to item analysis procedures to determine which test items produced the maximum differentiation, and (3) that a factor analysis of the intercorrelations for each of the seven samples studied should be developed in order to find a minimum number of psychological, interpretable dimensions about which test scales could be built.

The development of additional investigations as recommended might be instrumental in providing more objective methods for the guidance, selection, and admission of candidates to music education teacher training curricula.

Microfilm $3.90; Xerox $13.75. 304 pages.

THE RELATIONSHIP BETWEEN A TEST OF VISUAL SENSITIVITY AND JUDGED QUALITIES OF CHILDREN'S DRAWINGS

(Order No. Mic 61-2353)

Frank Bedogne, Jr., Ed.D.
The Pennsylvania State University, 1961

This exploratory study was undertaken to determine what relationship exists between visual sensitivity, as measured by a perceptual form sensitivity test, and the art work of children in grades three, five, seven, eight, and nine as judged on the basis of general quality (gestalt), awareness, and creativity. A second consideration was the relationship of verbal intelligence to the test and the judged qualities. Pearson Product Moment correlations followed by partial and multiple correlations were calculated.

A total of 156 public school children were subjects in this study: 26 in the third grade, 27 in the fifth, 28 in the seventh, 39 in the eighth, and 36 in the ninth. Each pupil took the perceptual form sensitivity test and also contributed four drawings, each drawing the result of a different motivation. The same test was given to all the children. The drawings were judged within grade level.

A fairly high, significant test reliability coefficient of .79 was found by means of the Kuder-Richardson method. The quality of each test item was determined to be satisfactory by an item analysis. The simple coefficients of correlation indicated significant relationships for the third grade and the seventh grade. The only coefficient that was noted as significant for the fifth and eighth grade was that computed between the test scores and the judged awareness. The ninth grade showed no significant correlations.

The partial correlations that were computed held the mental age constant. As seen against the test scores and the drawing judgment scores, the contribution of mental age was slight. This would seem to indicate that visual sensitivity, as measured in this study, involves a factor of intelligence other than the factor of verbal intelligence. Since verbal intelligence played such a minor role, the multiple coefficients were not very much higher than the original correlations.

At the fifth, eighth, and ninth grade levels there is reported to be a lowered capacity for coordinating visual experiences with the self. The low correlations at these levels are probably due to this condition. At the third and seventh grade levels where there is felt to be a much better integration of visual experiences and the self, the correlations are significant.

Microfilm $2.75; Xerox $4.60. 89 pages.

SELF-EVALUATION AND ACADEMIC ACHIEVEMENT

(Order No. Mic 61-2019)

Bernard Borislow, Ph.D.
University of Pennsylvania, 1961

Supervisor: Morris S. Viteles, Ph.D.

This study attempted to determine the importance of self-evaluation as a non-intellectual factor in scholastic achievement. A distinction was made between general self-evaluation and student self-evaluation. Assuming that general self-evaluation is an index of personality adjustment, it was believed that achieving students should exhibit higher general self-evaluation than would underachieving students prior to and subsequent to academic performance. In addition, general self-evaluation changes (in the direction of level of achievement) were predicted where students indicate an intention to strive for high grades, think highly of themselves as students, and accurately perceive their level of achievement. Finally, it was hypothesized that students who ultimately achieve at different levels should not differ in terms of student self-evaluation prior to academic performance but should differ subsequent to performance, where scholastic achievement is a prime goal.

A questionnaire was distributed to the entire incoming 1958 freshman class of the College of the University of Pennsylvania prior to the beginning of their first semester classes and again just after the receipt of their first semester grades. The questionnaire was designed to obtain measurements of general self-evaluation (self-ideal discrepancy), student self-evaluation (student self-ideal student discrepancy), intention to work toward scholastic achievement as a prime goal (pre-semester assessment only), and degree of perceived scholastic success (post-semester assessment only). In addition, information was obtained about the students' personal background and educational-vocational plans for the future.

As a result of a personal distribution (prior to the semester), and a mail distribution (after the semester), 197 students out of the total class of 361 responded to both the pre- and post-semester questionnaires. This fifty-five percent return resulted in a representative sample of their class on the important dimensions of scholastic aptitude test scores, grade point averages, and "scholastic achievement as a goal" scores.

Four experimental groups were constituted, first on the dimension of achievement level (via regression line of grade point average on scholastic aptitude test score) and, secondly, by the criterion of whether or not the student intended to strive for scholastic achievement as a prime goal. Eleven subjects were discarded from the analysis to insure the absence of scholastic aptitude differences between the achievement level groups. Two groups of "scholastic achievement high goal" (SA-High) subjects were constituted: Achievers (N=84) and Underachievers (N=21). These groups were compared on the experimental variables. In addition, two "scholastic achievement low goal" (SA-Low) groups were extracted and compared with each other. They were Achievers (N=55) and Underachievers (N=26).

The above groups were further refined by selecting subjects who had high student self-evaluation (prior to the semester) in order to test the hypotheses concerned with general self-evaluation change.

The following conclusions seem warranted:

1. Regardless of an intention to strive for scholastic achievement as a prime goal, students who underachieve scholastically cannot be distinguished from those who achieve scholastically on the basis of general self-evaluation prior to or subsequent to their first semester in college.

2. Students who underachieve scholastically have a poorer conception of themselves as students than do achievers subsequent to their scholastic performance, regardless of initial intention to strive for scholastic achievement as a goal.

3. Where students exhibit an intention to strive for scholastic achievement as a prime goal, underachievers have a more pessimistic conception of themselves as students than do achievers prior to their actual scholastic performance. This does not hold true where scholastic achievement is not a prime goal.

4. Where scholastic achievement is a prime goal, the student has a good conception of himself as a student, and does achieve scholastically, his general self-evaluation becomes more favorable from pre- to post-semester assessments. This does not hold true where scholastic achievement is not a prime goal.

The above findings were interpreted as lending support to the usefulness of a more specific ("role" or "capacity") self-evaluation theory which takes into consideration relevant motivation and not supporting general self-evaluation theory based on the global concept of personality adjustment, in investigating non-intellectual factors of academic achievement. Microfilm $2.75; Xerox $4.40. 84 pages.

AN EMPIRICAL COMPARISON OF THE SCHOOL AND COLLEGE ABILITY TESTS AND THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION

(Order No. Mic 61-2524)

Robert Burdette Clyde, Ed.D.
University of Southern California, 1961

Chairman: Professor Lefever

The purposes of this study were (1) to determine whether the Cooperative School and College Ability Tests, Level I (SCAT) will predict the academic success of college freshmen, as measured by grade-point averages, as well as the American Council on Education Psychological Examination, College Edition (ACE); (2) to discover whether the SCAT will predict aptitude for freshman major courses as well as the ACE; (3) to compare the predictive power of the SCAT and the ACE for men and women; (4) to investigate the predictive value of the SCAT and the ACE for advising terminal and transfer students in junior college and for making long-term predictions of college ability.

The SCAT and the ACE were administered to entering freshmen at two junior colleges in 1956. Total grade-point averages and grade-point averages for selected major courses were obtained for the freshman year. Pearson correlations and multiple correlations for general prediction, specific major prediction, and predictions using several subgroups were calculated. All correlations were tested for significance, and the predictive validity of the two tests was compared.

Findings and Conclusions. (1) The prediction of grade-point averages by both tests produced average correlations ranging from .21 to .45 for zero order and multiple correlations. Coefficients of correlation were significant at the 1 per cent level of confidence with few exceptions. (2) The predictions for liberal arts, mathematics-science, commercial, and technical majors yield significant correlations, with average zero order coefficients ranging from .20 to .41 and average multiple correlations ranging from .30 to .58. Correlations for professional business majors measured only small positive relationships for either test. (3) Both the SCAT and the ACE predicted the academic success of women students better for the first semester but predicted the grade-point averages of the men students better for the second semester. (4) In projecting the grade-point averages for further college work, the predictive power of both tests was greater for the second semester than for the first semester at each of the colleges. (5) There were significant differences in the grades of the lowest quarter and the highest quarter of the freshman class, as determined by the test scores. The large variability of the means, however, reduced the predictive value of the score differences. (6) There was no significant difference between the scores of the two tests in their ability to predict whether a student will drop out of college. (7) Both tests predicted grade-point averages for transfer students better than for terminal students. (8) There was no observed difference between the test results for the SCAT and the ACE attributable to the speeded nature of the ACE. (9) The intercorrelations among the part scores were high for both tests. All but one of the intercorrelations were very significant and showed substantial relationships. (10) The verbal and total scores for both tests were better predictors of academic success than were the quantitative scores. (11) The SCAT and the ACE are very similar in their predictive powers. (12) On the basis of the findings in this research, predictions for individual guidance should be made with caution. (13) The SCAT was slightly superior to the ACE in the types of prediction investigated. (14) The theoretical superiority of a concept test measuring intelligence and achievement in terms of developed ability was supported by the findings, but further empirical evidence is needed. Mircrofilm $2.80; Xerox $9.70. 215 pages.

DIFFERENCES BETWEEN CHILDREN WHO SPONTANEOUSLY OUTGREW AND CHILDREN WHO RETAINED FUNCTIONAL ARTICULATION ERRORS

(Order No. Mic 61-2112)

Stanley Dickson, Ed.D.
The University of Buffalo, 1961

INTRODUCTION

Children in the early primary grades often have numerous speech errors which are not due to pathological organic conditions or serious emotional disorders. Such errors are identified as functional articulation errors. Many kindergarten, first and second graders spontaneously outgrow these errors while some children retain them. Research has demonstrated that some children may continue to have errors until seven and one-half years of age. In order to predict which children will spontaneously outgrow functional articulation errors and which children will retain errors, it may be necessary to identify those variables which seem to differentiate these two populations. A review of the literature reveals that three of the most mentioned differences between children with functional articulation defects and so called "normal" children are auditory discrimination, motor proficiency, and environmental factors.

The purpose of this study is to answer the following questions:

1. Are there differences in motor proficiency between children who outgrew functional articulation errors and children who did not outgrow functional speech errors?
2. Are there differences in auditory discrimination between these two groups?
3. Are there differences in the emotional characteristics of the parents of the children in the two groups?

PROCEDURE

Thirty children were identified as once having speech errors but spontaneously outgrew them and thirty as having retained speech errors. The Templin Speech Sound Discrimination Test and the Oseretsky Test of Motor Proficiency were administered to the children. The significance

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

of the difference between the mean scores obtained for the two groups was tested. The Minnesota Multiphasic Personality Inventory was mailed to the parents of the children and 69 per cent of the parents completed and returned the inventory. The significance of the difference between the mean scores obtained for mothers, fathers, and parents (mothers and fathers combined) was tested for each of the fourteen scales of the M.M.P.I. The difference between the proportion of positive responses for each group for the 550 items of the M.M.P.I. was also tested.

RESULTS

1. No significant difference was found between the two groups in Templin Test Mean Scores.
2. Group A (non speech defective) obtained a mean score significantly higher than Group B on the Oseretsky Test.
3. Mothers in group B obtained a significantly higher mean score on scale 3 (Hy) of the M.M.P.I.
4. Fathers in group A obtained a significantly higher score on scales 6 (Pa) and K.
5. Parents in group B omitted significantly more items than parents in group A, thereby obtaining a significantly higher mean score on the (?) scale.

All of the mean scores were within one standard deviation of the "normal" adult Minnesota standardization group. A significantly greater proportion of mothers in group B obtained T scores of 60 or greater. These scores occurred on scales 1, 2, or 3 (the "neurotic triad") consistently.

The null hypothesis of no difference between the groups for each item of the M.M.P.I. was rejected for 12 items for mothers; 15 items for fathers, and 16 items for mothers and fathers combined. These are fewer discriminating items than would be expected to occur by chance or sampling error.

SUMMARY AND CONCLUSIONS

The results suggest that the speech defective group is inferior in gross motor tasks. There are some tentative indications that the mothers of the speech defective group are more emotionally "immature and unstable" than the mothers of the children who outgrew speech errors. These factors may contribute to the retention of speech errors of children in the early primary grades.

Microfilm $2.75; Xerox $5.60. 115 pages.

SOME APPARENT RESULTS OF COLLEGE READING IMPROVEMENT PROGRAMS RECONSIDERED IN TERMS OF THE METHOD OF MEASURING IMPROVEMENT

(Order No. Mic 61-2531)

Richard Cheves Hardison, Ed.D.
University of Southern California, 1961

Chairman: Professor Meyers

Preliminary observations led to the hypothesis that levels of reading ability might vary in accordance with the measurement process used in evaluating that ability. In turn, college reading improvement programs might yield results that reflect the nature of the measurements as well as the effects of the courses themselves.

Many reading tests evaluate comprehension in terms of the total amount of material gathered in a fixed period of time. College reading, however, commonly demands a thoroughness of understanding and may logically place emphasis on the percentage of comprehension rather than on total comprehension. This study investigated both the success that college reading improvement programs have in modifying the percentage of comprehension, and the extent to which the results of such a program may appear to vary when evaluated by different test procedures.

The subjects were 403 college students in ten groups of one-semester reading improvement courses, and 123 control students. The course stressed rate improvement and depended considerably on such devices as the Tachistoscope, Reading Pacer, and metronoscopic films. Measures of reading ability were secured both at the beginning and at the end of the course. The Iowa Silent Reading Tests were used. One form was administered in the standardized way, wherein the amount comprehended is permitted to be a function of the amount read. Another form was used with modifications in administration and scoring designed to evaluate rate of reading on the one hand and percentage of comprehension on the other.

Findings. When the standard administration of the Iowa Silent Reading Tests was the criterion of reading abilities, students made gains in reading rate and in total comprehension well beyond the one per cent level of confidence. The mean rate gain was 82.5 words per minute, and the mean comprehension gain was 3.86 questions answered correctly. Rate gains and comprehension gains correlated .72. The modified Iowa resulted in a different pattern of reading changes. Following the semester of reading improvement work, losses in percentage of comprehension were found well beyond the one per cent level of confidence. A negative correlation was found for changes in rate and changes in percentage of comprehension (-.53) and for total comprehension changes and changes in percentage of comprehension (-.43). Results, as described, were essentially the same for all ten groups. A correction for guessing adjustment, applied to two of the groups, affected the amount of comprehension measured but did not show significant difference in the quantity of gains. It became apparent that the results of a college reading improvement program were, at least in part, a function of the testing instrument.

Implications. Justification of many mechanical devices, as well as of teaching procedures frequently used in college reading improvement work, often rests on evidence of comprehension gains, yet it may be that these gains are not indicative of the kind of comprehension that is necessary in the college environment. In short, the measuring devices may lead to questionable conclusions. Some forms of reading tests confuse the qualities of rate and comprehension, while intending to separate them, and succeed only in permitting rate of reading to influence the measurements of all reading skills. Consequently, many research findings of profit from reading programs may be less conclusive than they first appeared.

Microfilm $2.75; Xerox $5.80. 118 pages.

A STUDY OF THE GUIDANCE RESOURCES OF STUDENTS IN HIGH SCHOOLS AFFILIATED WITH THE NATIONAL UNION OF CHRISTIAN SCHOOLS IN MICHIGAN AND ILLINOIS

(Order No. Mic 61-1171)

Lester James Harvey, Ph.D.
Michigan State University, 1960

THE PROBLEM

The study was concerned with gathering basic data regarding the problems and guidance resources of students in Christian high schools affiliated with the National Union of Christian Schools. The study was designed to draw together basic information which could be utilized in planning and assessing the guidance of these Christian high school students.

The following general null hypotheses were tested:

1. There will be no differences in the number of total problems and serious problems checked by Christian high school students on the Mooney Problem Check List when compared on the basis of grade level, sex, and size of school in each of the eleven Mooney problem areas.

2. There will be no differences between Christian school students and comparable public school students in the number of total and serious problems checked in the eleven Mooney problem areas.

3. There will be no differences between Christian school leaders and teachers perceptions of the sources of guidance their students should use in the eleven Mooney problem areas.

4. There will be no differences between Christian school leaders and teachers perceptions of guidance sources the students should use and the students report of sources utilized in the eleven problem areas.

5. There will be no differences between the Christian school students on the basis of grade level, sex, and size of school concerning the sources of guidance they report they use in each of the problem areas.

THE METHODOLOGY

The Mooney Problem Check List, High School Form, 1950 Revision, and a Sources of Guidance Questionnaire, developed for this study in Adult and Student Forms, were the two criterion instruments employed. Each instrument was administered to a 12.5% stratified random sampling of tenth, eleventh, and twelfth grade students in nine "Christian" high schools in Michigan and Illinois. The questionnaire was also given to a sample of students from four public schools matched on the basis of size and location with Christian schools in the study. The Adult Form of the questionnaire was administered to a 25% sampling of the Christian school teachers and to a leader group delineated by the Christian school administrators. The eleven problem areas of the Mooney Problem Check List formed the structure for the development of the questionnaire and for the comparisons made within the study.

The comparisons involving the students' problems were carried out through the use of the median test for two samples. The Sources of Guidance Questionnaire data were contrasted by employing the chi square test and 2 x 2 contingency table. The .05 level of significance was used to accept or reject hypotheses.

RESULTS

1. There were significant differences between the sexes concerning problems marked but differences were not apparent between students on different grade levels or in different sized schools.

2. There were significant differences between Christian school males and public school males concerning problems checked but only one area of difference between Christian school females and public school females.

3. Christian school leaders and teachers agree concerning the "ideal" primary sources of guidance for Christian school students in ten of the eleven problem areas.

4. There are significant differences between the "ideal" sources of guidance listed by the leaders and teachers and the sources of guidance the students report they do use in over half of the Mooney problem areas.

5. Students of different sexes, grade levels, and sized schools do not differ basically in the sources of guidance they report using.

Microfilm $2.75; Xerox $8.40. 181 pages.

A FACTOR ANALYSIS OF AN ATTITUDE SCALE TOWARD RETARDATION WITH A POPULATION OF PARENTS OF EDUCABLE MENTALLY HANDICAPPED CHILDREN

(Order No. Mic 61-1491)

Jean Ruth Hebeler, Ed.D.
Syracuse University, 1960

Supervisor: William M. Cruickshank

The purpose of this study was to investigate the underlying structure of attitudes toward retardation as measured by the 33 subscales of the Attitude Scale Toward Mental Retardation (AMR) when administered to a population of parents of educable mentally handicapped children.

The Attitude Scale Toward Mental Retardation was administered to 91 middle-class[1] parents of school age educable mentally handicapped children. This instrument is composed of 256 items each containing a non-personalized reference to retardation. The items are responded to and scored according to a 4-point scale of Strongly Agree, Mildly Agree, Mildly Disagree and Strongly Disagree. They are logically categorized into 33 subscales according to their clinical content emphasis.

Pearson Product Moment correlations were obtained for the summated category scores of the sample population. The resultant matrix of intercorrelations was then factor analyzed by Rao's Canonical Method.[2] Seven factors were obtained by this iterative procedure before the residual variance reached a non-significant level. Names given the derived factors on the basis of their psychological content are: I Restriction, II Striving for Achievement and Acceptance, III Autonomy-Democratic Understanding, IV Awareness of Self, V Expression-Suppression, VI Submission-Acknowledgment, and VII Interactive Control.

The bulk of the variance is accounted for by the first three factors. These factors were thus more easily and reliably definable in terms of their dynamic psychological content areas. They seem to represent the more inclusive aspects of the personal reaction to retardation in contrast to a more limited focus shown on the remaining less significant four sets of loadings (Factors IV, V, VI, and VII).

The results of this analysis basically enhance the understanding of the major facets of parental attitudes toward retardation as measured by the Attitude Scale Toward Mental Retardation. Their utilization in enriching the interpretative and descriptive uses of the AMR as a tool in working with parents of the retarded is anticipated.

This investigation is recognized as a preliminary attempt to delineate the major underlying aspects of behavior measured by the AMR. The results obtained can at the present time only be applied to this population. Subsequent investigations with similar populations as well as those with different and more homogeneous characteristics will add to the usability of the Scales for descriptive, diagnostic and research purposes.

1. W. L. Warner, M. Meeker, and K. Eells, Social Class in America (Chicago: Science Research Associates, Inc., 1949).

2. C. R. Rao, "Estimation and Tests of Significance in Factor Analysis," Psychometrika, XX (1955), 93-111.

Microfilm $2.75; Xerox $9.00. 200 pages.

PREDICTION OF STUDENT ACADEMIC ACHIEVEMENT IN BEGINNING GERMAN AT PURDUE UNIVERSITY

(Order No. Mic 61-2481)

W. Merle Hill, Ph.D.
Purdue University, 1961

Major Professor: Dr. Frank J. Woerdehoff

This investigation is an attempt to devise a suitable procedure for predicting student academic achievement, based on intellectual and non-intellectual factors, which could be applied to students enrolling in first semester German classes at Purdue University.

The intellectual variables involved are: rank in high school graduating class, previous Purdue Grade Point Index, Purdue freshman orientation scores in English and mathematics, and German orientation reading and total scores for those students who had had prior experience with the German language.

The non-intellectual variables involved are: sex, age, semester in school, and whether or not German was being taken as an elective. In addition, three variables were available for the cross-validation group alone: course load, hours of outside employment, and socio-economic status of the family.

The predictor population consists of 1,255 students at Purdue University who received a final grade in first semester German from 1954-59. The cross-validation group for which predictions were made consists of 280 students who were enrolled in first semester German at Purdue during the fall semester of the school year 1959-60.

The collected data were broken down into four different variable sub-groups: freshmen variables, upperclass variables, high school German variables, and cross-validation group variables. Since the cross-validation group variables were gathered only for future use and since such a few students in this group had had prior German language experience, only the freshmen variables sub-group and the upperclass variables sub-group were used for final prediction.

Major Findings:

1. For the freshmen variables sub-group, the best single predictor of a final grade in first semester German at Purdue University was the student's rank in his high school class (r = .4699), which was followed by the orientation scores in English (r = .4522) and mathematics (r = .3795).

2. The best single predictor for the upperclass variables sub-group was the Purdue Grade Point Index (r = .5109), which was followed by high school rank (r = .4627) and the orientation scores in English (r = .4434) and mathematics (r = .3468).

3. The best combination of freshmen variables selected by the Wherry-Doolittle Method resulted in a correlation coefficient of .57 between predicted and actual grades of the cross-validation group. The multiple regression for the freshmen variables is:

$\hat{Y} = .14861 + .04113X_1 + .01294X_2 - .33508X_3$, where

X_1 = Normalized high school rank
X_2 = English orientation score
X_3 = Elective (1 = yes, 2 = no)

4. The best combination of upperclass variables selected by the Wherry-Doolittle Method resulted in a correlation coefficient of .56 between predicted and actual grades for the cross-validation group. The multiple regression equation for the upperclass variables is:

$\hat{Y} = -1.1455 + .02109X_1 + .01063X_2 + .48527X_3$, where

X_1 = Normalized high school rank

X_2 = English orientation score

X_3 = Purdue Grade Point Index

Conclusions:

This investigation represents an effort to utilize intellectual and non-intellectual data available at Purdue for predictive and educational guidance purposes. The study is a beginning effort in pursuing a full scale program for the prediction of student academic achievement in the various courses offered by the Department of Modern Languages. Basic to this investigation is the attitude that the prediction of language success at Purdue is possible. Sectioning of the language classes into ability groups would be a desirable consequence of such investigations. This study may point the way toward future language research and better educational guidance for language students at Purdue.

The major conclusions on the findings of this study are:

1. The educational guidance of students in beginning German classes may be enhanced by using background data of an intellectual, as well as of a non-intellectual, nature that is available prior to enrollment in beginning German language classes.

2. The improvement to be gained by using such data is by no means as great as one might wish, since no single predictor, intellectual or non-intellectual, proved sufficient to predict student success in beginning German by itself.

3. The most efficient single predictor of student academic achievement in first semester German was the Purdue Grade Point Index. However, for those students for whom no previous Purdue grades were recorded, high school rank was the most effective predictor, followed by the English orientation score.

4. A battery of variables proved to be somewhat more effective in predicting student academic achievement in first semester German classes than any single variable. Whereas in each instance the improvement in prediction efficiency gained by combining the variables was not great, it was large enough to justify such combinations.

5. The two regression equations utilized for predictive purposes appear not to predict student academic achievement in first semester in the A and F grade categories. These two equations do appear to be able to predict such achievement quite accurately at the C grade level and with a lesser degree of accuracy at the B and D grade levels. Further refinements of this predictive procedure appear to be necessary.

Microfilm $2.75; Xerox $7.40. 157 pages.

VALIDITY CONCOMITANTS OF VARIOUS SCORING PROCEDURES WHICH ATTENUATE THE EFFECTS OF RESPONSE SETS AND CHANCE

(Order No. Mic 61-2532)

Kenneth Dean Hopkins, Ph.D.
University of Southern California, 1961

Chairman: Professor N. Metfessel

The problem leading to this investigation arose when it was noted that on certain standardized achievement tests an examinee could achieve grade level status by chance alone. Response sets, if present, would introduce additional ambiguity into the meaning of the test scores. The purposes of this study were (1) to determine whether gambling and positional preference response sets were present in elementary school pupils and (2) to evaluate the effects on validity of various scoring procedures designed to attenuate chance and response set variance.

The sample of 246 fifth grade students was divided into two groups on the basis of previous achievement and intelligence test results. One group took the arithmetic sections of the SRA Achievement Series and the other took the corresponding sections of the California Achievement Tests. After taking the tests in the standardized manner, an alternate form of the same test was administered one week later in recall form, i.e., without response options. This test was administered under power conditions. The results served as the criterion for coincident validity, as they provided an appraisal of an examinee's true ability to deal with the particular content area without the contaminating effects of chance and response sets.

Findings. After it had been established that speed factors were negligible on the tests, an evaluation of the hypothesized set to gamble was made. The set was present to a highly significant degree as determined when using Ziller's risk-acceptance model. The set was more prevalent among boys.

The hypothesis of a positive relationship between ability and tendency to follow directions regarding guessing was supported.

No evidence for intraindividual and interindividual positional preference response sets was found.

The results regarding the most efficacious scoring method differed among the tests. On the CAT the highest validity coefficient was obtained when a correction for chance was made after responses marked in the "don't know" option were disregarded. However, this coefficient was not significantly higher than those obtained by using certain of the cutoff scoring methods which focused only upon the performance of an examinee before reaching his ability limen. On the SRA tests the forced completion, conventional number right, and certain of the cutoff methods yielded validity coefficients which were not significantly different. For the low ability examinees, however, certain of the cutoff procedures were found to be superior.

In general, the forced completion method had little to commend it. The cutoff methods showed some promise for use on tests which must span wide ability ranges. Correction formulas, used in conjunction with "don't know" options, had definite advantages on certain tests. The tests

using an alternative "don't know" option had lower mean indexes of risk-acceptance and higher coefficients of coincident validity.

Recommendations. The study demonstrated that no one scoring method is best for all tests. Consequently, it is recommended that test publishers determine the most desirable scoring procedure before marketing a particular test. When a test must cover a wide range of ability, the use of differential scoring methods at various ability levels should be investigated. The study also suggests that greater consideration be given to test difficulty by standardized testers. Since individual differences are so great even within a single grade level, it might be profitable for two or three forms of a test to be available for a particular grade, differing only in difficulty. Such a procedure would seem to increase both the validity and reliability of achievement tests, especially for the extreme ability groups.

The need for test publishers to report coefficients of coincident validity was also suggested by the study. Without such information irrelevant variance could be sizable and yet be unidentified.

Microfilm $2.75; Xerox $5.20. 104 pages.

PERSONALITY DIFFERENCES AND SIMILARITIES BETWEEN OFFENDER AND NON-OFFENDER AIR FORCE MOTOR VEHICLE OPERATORS

(Order No. Mic 61-2551)

Willis Jones Hubert, Ph.D.
New York University, 1961

The problem in this investigation was to determine what differences and similarities exist between Air Force motor vehicle operators with high incidence records of traffic offenses (accidents and violations) and those with low incidence records of such offenses, with respect to selected psychological factors.

Traffic accidents are the leading source of accidental deaths in the United States and in the Air Force. In the Air Force in 1958 a total of 525 airmen were killed and 4,447 sustained other disabling injuries in traffic accidents, at an estimated cost of $21,628,822. Notwithstanding the emphasis placed on manipulative skills, physical qualifications, and knowledge of traffic rules and regulations; traffic accidents continue to take a tremendous toll of human and material resources each year.

Findings in previous studies have indicated that accident repeater drivers tend to have certain characteristics in contradistinction to low accident drivers. The findings, however, do not enable one to reliably predict which drivers will be more liable to accidents. Investigators have emphasized the need for further research before such findings may be used to screen potential drivers.

In addition to the psychological influences ordinarily confronting drivers, military drivers are subjected to the military system's authoritarianism. This factor is believed to affect driver behavior, emphasizing the importance of this psychological study.

A questionnaire survey of Continental Air Command drivers was conducted to obtain age, education, driving experience, traffic accident and violation data. This data was cross-checked against certain comparable data from official Air Force records. The investigation was limited to 20 to 25 year old drivers with no physical limitations, who had completed at least the eighth grade and driven a minimum of 50,000 miles since January 1, 1950. Thirty-one drivers with two or more accidents and violations composed the offender group. Thirty-two drivers with no accidents or violations composed the non-offender group.

The Guilford-Zimmerman Temperament Survey and the Sacks' Sentence Completion Test were administered to obtain psychological information. The percentage difference between study groups was computed for the Guilford-Zimmerman survey's trait areas and the Sacks' personality areas. The standard error and critical ratio were computed to determine the significance of percentage differences. The difference between mean scores for each trait and personality area was also computed. The standard deviation, standard error, and critical ratio were calculated to determine the significance of differences between mean scores.

The relationship between personality differences and records of traffic behavior was determined by correlating survey and test scores for each trait and personality area in which the critical ratio of the percentage difference was 1.50 or higher, with offense records of offender drivers. Also, mean scores of offender drivers were correlated with their offense records. Coefficients of correlation were tested against the null hypothesis to determine their significance.

Significant differences at the .05 level were found to exist between offender and non-offender driver groups in the "objectivity" trait area of the Guilford-Zimmerman survey, and in the personality areas "attitude toward superiors..." and "religion" of the Sacks' test. Significant differences at the .10 level were found to exist in four other Guilford-Zimmerman trait areas, and one other Sacks' personality area.

The coefficient of correlation between test scores in the mildly disturbed category of the Sacks' personality area "attitude toward superiors...", and traffic offense records, was significant at the .10 level. A few other coefficients of correlation were sufficiently high to suggest trends warranting investigation.

It was concluded that in licensing drivers more attention should be given to personality characteristics. Additional research will be required to accomplish this objective. The Air Force should sponsor further research in this area. Microfilm $2.75; Xerox $4.20. 79 pages.

A STUDY OF NONINTELLECTUAL FACTORS RELATED TO ACADEMIC ACHIEVEMENT AMONG COLLEGE SENIORS AT BALL STATE TEACHERS COLLEGE

(Order No. Mic 61-2482)

James G. Hunt, Ph.D.
Purdue University, 1961

Major Professor: Lee E. Isaacson

Purpose

The purpose of this study was to identify certain nonintellectual factors which were associated with academic achievement among college seniors who were overachievers and underachievers at Ball State Teachers College. Factors investigated were (1) personality characteristics, (2) age, (3) occupational group and level of father or guardian, (4) size of family in terms of number of siblings, (5) educational level of parents, (6) size of high school graduating class, (7) period in life when occupational choice was made, (8) membership in social sorority or fraternity, (9) living facilities, including residence halls, private homes, fraternity houses, home town residence and commuting, (10) marital status, (11) transfer hours from other colleges and universities, (12) amount of education financed by self, (13) hours of outside employment, (14) military status, and (15) number of years employed during the college career.

Procedure

Effects of personality characteristics were assessed by use of the California Psychological Inventory (CPI) and data concerning the other variables were obtained by employing a personal history questionnaire and appraising school records.

Subjects were Ball State Teachers College seniors who (1) had completed at least 140 quarter hours of academic work, and (2) scored between the thirty-fourth and sixty-sixth percentiles on the American Council on Education Psychological Examination (ACE) as freshmen. The predicted academic progress of the group was average. Their cumulative grade point ratios (GPR) were then examined and they were ranked from highest to lowest. The top GPR was 3.857 with the lowest being 1.931. (A = 4:00)

A buffer zone was then created to separate overachievers from underachievers and to eliminate normal achievers from the investigation. The all senior average computed at the termination of the Autumn Quarter, 1959, was 2.663 and subjects with grade point ratios clustering about this point were eliminated from the study. It was arbitrarily decided that the extreme ends of this buffer zone would be 2.500 and 2.800. By this method, sixty-four subjects who had attained grade point ratios ranging from 2.800 to 3.857 were designated as overachievers and eighty subjects who had attained grade point ratios ranging from 1.931 to 2.500 were designated as underachievers. The sixty-four overachievers included thirty-eight women and twenty-six men while the underachievement group consisted of thirty-four women and forty-six men. Fisher's "t" test for comparing means of unmatched groups was employed and the mean ACE scores of the two groups were not found to differ significantly.

A total of 127 students completed the inventory and questionnaire. This included sixty-three of the sixty-four overachievers and sixty-four of the eighty underachievers. The mean ACE scores of the two male groups were not found to differ significantly but there was a significant difference concerning GPR. Tests of significance concerning ACE raw score data and GPRs for females followed an identical pattern. Therefore, the groups were of equal ability as measured by the ACE but unequal in achievement as determined by GPR. Male overachiever responses to the questionnaire and inventory were compared with male underachiever responses by utilizing Fisher's "t" for comparing means of unmatched groups. Female overachievers were compared with female underachievers in a like manner.

Findings

1. At the .01 level of probability, it was found that male overachievers differed significantly from male underachievers in terms of size of high school graduating class. The male overachievers matriculated from classes whose membership exceeded 300 or more students while the underachievers, on the average, came from classes ranging from fifty to slightly over 100 students.
2. None of the eighteen scales of the CPI differentiated between male underachievers and male overachievers in this investigation at the .01 level of probability. However, the "t" value observed for the comparison of the male responses to the Psychological-Mindedness (Py) scale fell between the .05 and .01 levels of probability.
3. No comparisons of female responses to the personal history questionnaire produced significant "t" values at the .01 level of probability. However, five "t" values were observed which fell between the .05 and .01 levels of probability and these comparisons concerned (1) age, (2) hours employed during the first three years of college, (3) year pledged in a sorority, (4) number of older brothers, and (5) number of older sisters.
4. At the .01 level of probability, the CPI scales of Dominance (Do), Tolerance (To), and Achievement via Conformance (Ac) differentiated between the two female groups in the investigation. Other "t" values ranging between the .05 and .01 levels of probability were observed for the scales of Responsibility (Re), Good Impression (Gi), and Achievement via Independence (Ai).

Conclusions

1. Senior female students at Ball State Teachers College are more predictable, at least in terms of academic achievement, than are male students. The overachieving female has a flexible point of view and is able to adapt herself in the academic setting as the instructional situation demands. This is illustrated by the fact that female overachievers differed from female underachievers on both of the achievement scales of the CPI.
2. With six scales of the CPI making a differentiation between the two female groups, it is felt that the utilization of the CPI as a device to supplement current admissions techniques for females at Ball State Teachers College would be of value. The findings of this investigation do not support the same conclusion for male overachievers.
3. The following nonintellectual variables do not differentiate significantly male or female overachievers and

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

underachievers: (1) transfer hours, (2) age, (3) number of hours employed during the senior year, (4) number of years employed during the college career, (5) number of hours employed during the first three years, (6) mother's educational level, (7) father's educational level, (8) marital status, (9) number of children, (10) amount of education financed by self, (11) sorority or fraternity membership and year pledged, (12) place of residence, (13) number of older brothers and sisters, (14) number of younger brothers and sisters, (15) time in life when occupational choice was made, and (16) occupational level of parent or guardian. Microfilm $2.75; Xerox $6.00. 124 pages.

SOME RELATIONSHIPS BETWEEN CREATIVE WRITING AND CREATIVE DRAWING OF SIXTH GRADE CHILDREN

(Order No. Mic 61-2377)

Clyde Adam Jones, Ed.D.
The Pennsylvania State University, 1961

The purpose of this study was to investigate some possible relationships between creative writing and creative drawing of sixth grade children, and the relationships of these measures to other creative abilities. Two theories were involved. One was advanced by Lowenfeld and Beittel that there are universal qualities of creativeness common in the arts and sciences. The other was the theory of J. P. Guilford which suggested that there might be common factors, yet these could be varied in pattern and relationship. Guilford proposed his semantic divergent-production tests and figural divergent-production tests as related to the two areas of expression.

The population consisted of 150 sixth grade children from State College and Tyrone, Pennsylvania, elementary schools.

The data included examples of creative writing and creative drawing. Twelve paper and pencil tests were administered. Guilford's semantic tests were: Filling Blanks, Ways To Use It, Names For Stories, and Making A Plan. His figural tests were: Sketches, Decorations, Making Objects, Dot Systems, Match Problems IV, and Monograms. The SRA-Primary Mental Abilities, Word Fluency test and the Sketch Fluency Test (designed by the investigator) were included in the respective test batteries.

Criteria judgments of the writing and drawing were made by a group of judges in each area. An eleven-point rating scale was utilized for the two criteria, creativeness and freedom in handling materials. The number of descriptive words and the total number of words were used as additional criteria for the writing. The amount of detail was judged as a third criterion in drawing. A composite criterion included both creativeness and freedom in handling materials as a single criterion.

There were twenty-six variables. These were the scores on the twelve tests, the total of all the semantic test scores (one test was scored for two purposes), the total of all the figural test scores, the seven criteria measures for the creative expression, two composite criterion measures, mental age, and reading achievement scores.

The ratings of the creative expression were based on the "best performance" of the child's total of three performances.

The results of the statistical analysis suggested that the Guilford test measures were reliably representative of the semantic and figural divergent-production abilities important in writing and drawing expression. Both mental age and reading achievement correlated at a moderate, but significant, degree with the two test batteries as well as with the criteria of writing and drawing. Correlations between the Word Fluency test and the semantic test battery, and the Sketch Fluency Test and the figural test battery were significant. Substantial relationships existed when the two test batteries were compared criteria-wise with each area of expression, writing and drawing.

From the results obtained by the correlational analysis of the data gathered in this study, the following conclusions were drawn:

1. The low positive, yet significant, relationships between specific criteria judgments in both creative writing and creative drawing support the theory advanced by Lowenfeld and Beittel of common attributes of creativeness in the arts.
2. The significant intercorrelations between the semantic divergent-production tests and the figural divergent-production tests of Guilford suggest that the two test batteries function as suitable predictors of creativeness. Since there appears to be a dependent relationship within the two test batteries, these batteries may be better able to predict general creativeness than creativeness in a special area.
3. With the two associated problems of the study, these specific conclusions are suggested:
   a. The low and significant relationships between the semantic divergent-production tests and creative drawing indicate that the semantic tests may be less satisfactory in predicting creativeness in drawing expression than the figural tests.
   b. The moderate and significant relationships between the figural divergent-production tests and the creative writing reveal that the figural tests may, to some extent, predict creativeness in written expression.

   These conclusions corroborate Guilford's theory that there may be variations of emphasis with common factors of creativity in the arts.

Microfilm $3.60; Xerox $12.60. 279 pages.

THE EVALUATION OF TEACHER CONSULTATION COMPARED WITH CASEWORK AND COMMUNITY SERVICES AS REFLECTED BY CERTAIN AREAS OF GROWTH AND LEARNING IN ELEMENTARY SCHOOL CHILDREN

(Order No. Mic 61-330)

Florine Klingenstein Katz, Ph.D.
New York University, 1960

The study evaluated and compared two kinds of services to teachers and children in an underprivileged area in New York City. There were two experimental groups, one of which received full community services, casework, and psychological evaluation for children and their families. The children's teachers attended case conferences. The other experimental group received only teacher consultation. A third, the control group, received no extra services.

Six third-grade classes were studied. The classes were formed into three groups. In each group there was one class with a relatively high reading level at the beginning of third grade and one of average reading ability. Experimental Group 1 was in one school; Experimental Group 2 and the Control in another. The 152 Negro children studied came from the same underprivileged socio-economic population. The schools were in the same school district, with a population 97 per cent Negro; staffs were stable; services from the Board of Education were the same; the same percentage of families was receiving welfare. Teachers in the study were licensed by the State and City of New York and were rated "very good" by their supervisors.

Group tests were administered just before the beginning and just before the end of the spring term to evaluate changes in the children's intelligence, reading achievement, and social-emotional adjustment. Teachers rated the children's behavior before the beginning and at the end of the term. Results of the changes were analyzed statistically.

It was hypothesized that there would be significant differences between the experimental groups on the one hand and the control group on the other in the three areas measured; and that there would be no significant differences found in these areas between the experimental groups. The first hypothesis was rejected in every instance; the second hypothesis was sometimes negated and sometimes supported as follows:

1. No significant differences were found in changes in intelligence quotients among or between groups. Thus, the second hypothesis is supported.

2. Experimental Group 1 made significantly more progress in reading achievement than Experimental Group 2, negating the second hypothesis. This finding raises the question as to the possible lessening of teacher interest in teaching academic subjects through a consultative process which stressed mental hygiene.

3. No significant differences were found in changes among or between groups in social-emotional adjustment as measured by tests given to the children. The second hypothesis was thus supported. Qualitative analysis yielded results of interest for the cultural and socio-economic group studied. Drawings and comparison of the results of one of the tests used with the test's norms, indicated a maturity and independence in these youngsters in advance of the middle-class children on whom the test was standardized. The results also indicated a tendency for these children to hit out in frustrating situations more than middle-class children, but, at the same time, a tendency toward resignation in the face of certain kinds of frustration, possibly that experienced in a school setting.

4. Significant differences were found in the changes in teachers' ratings of children's behavior. Teachers of Experimental Group 2 found their pupils significantly better adjusted at the end of the term than did teachers of Experimental Group 1. Thus the second hypothesis was negated. This finding raises two questions: First, were the children of Experimental Group 2 actually better adjusted or had consultation made the teachers more optimistic and accepting than they had been? and secondly, were the children in Experimental Group 1 actually more maladjusted or had the casework approach emphasized pathology so that the teachers saw it where they had not seen it previously?

Microfilm $3.50; Xerox $12.15. 269 pages.

THE CONSTRUCTION AND VALIDATION OF A TEST OF CERTAIN FACTORS IN WRITING ABILITY AT THE COLLEGE FRESHMAN LEVEL

(Order No. Mic 60-5587)

Helen Jeanette Kenney, Ed.D.
Boston University School of Education, 1959

Purpose of the Study: The study was undertaken for the purpose of constructing and evaluating a measure of selected abilities involved in the writing tasks commonly demanded of college freshman students.

Test Design: The final test consisted of measures of four abilities which appeared to be important factors in the educational tasks involving written expression at the college freshman level, to be susceptible to objective measurement, and to respond to specific teaching. Two forms of the test were developed after preliminary material had been tried out informally with a group of high school seniors and a small group of college freshmen. Each form included the following battery of subtests:

Part I—Flow of Ideas—A measure of ability to utilize personal experiences as a source of ideas for writing.

Content: Brief descriptions of five situations involving experiences which most college freshmen have in common.

Task: The student is asked to react to the items by writing all the ideas that are suggested by the situation.

Scoring: Each response is given a score of 2, 1, or 0 according to stated criteria. Sample responses are provided to guide the scorer in assigning values.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

Part II—Written Recall—A measure of ability to recall and report in writing material which has been read and studied.

Content: Two brief passages (approximately 425 words each) based on material which would not likely be familiar to most entering college freshmen but which would be similar to material encountered in regular classwork.

Task: The student is asked (1) to read and study each selection and to write a complete account from memory, and (2) to answer a series of objective questions following each selection. The questions are included to check on the student's ability to understand the thought content in the selection.

Scoring: Each idea recalled is given a score of 2, 1, or 0 according to stated criteria of accuracy and completeness.

Part III—Sentence Flexibility—A measure of ability to arrange ideas in a variety of sentence patterns.

Content: Based on the student's written recall account.

Scoring: Credit is granted on the basis of the variety and clarity of the sentence patterns used in the account.

Part IV—Vocabulary Richness—A measure of ability to use an exact and vivid vocabulary.

Content: Five sentences, grammatically correct, but too vague and general to be effective.

Task: The student is asked to rewrite each sentence replacing the dull, omnibus words with specific, concrete words and phrases.

Scoring: Credit is granted for substitutions of concrete words or phrases for the various elements of the sentence according to stated criteria. Sample responses are provided to guide the scorer in assigning values.

Test Tryout: The two forms of the finished test were administered to 255 freshmen at Boston College in two separate testing sessions in October, 1957. Absences reduced the number for whom both test scores were available to 229.

Analysis of the Test:

1. Although factors measured by the Test of Certain Factors in Writing Ability show definite relationships to reading comprehension, verbal ability, and general mental ability, the test does not appear to be measuring essentially the same abilities. Typical correlations of the various subtests were: reading comprehension (.35), verbal ability (.34), general mental ability (.24).
2. The various subtests are each measuring substantially different abilities. Intercorrelations ran as low as .11 and .18.
3. The test has very little predictive power in relation to English composition grades. Correlations by subtest ran about .15.
4. Test reliability is sufficiently high to justify the use of the test as a tool to identify broad groupings of students in terms of their relative competencies in the various abilities measured. Total test reliability was .66.
5. Reader reliability varied from .48 to .83; there were indications that with minor modifications the scoring techniques could yield higher reader reliability.
6. Each item in each subtest easily discriminated between high and low scorers.

Microfilm $2.75; Xerox $9.00. 199 pages.

AN EXPERIMENT TO DETERMINE THE EFFECT OF LEARNING CONVERSATIONAL FRENCH ON ACADEMIC ACHIEVEMENT OF THIRD GRADE CHILDREN: AN INVESTIGATION TO DETERMINE WHETHER INSTRUCTION IN CONVERSATIONAL FRENCH IN THIRD GRADE CLASSES IN SUBURBAN AND METROPOLITAN NEW YORK SCHOOLS WILL AFFECT ACHIEVEMENT IN READING, ARITHMETIC, SPELLING, AND LANGUAGE.

(Order No. Mic 61-2557)

Esther Wolf Lopato, Ph.D.
New York University, 1961

The purpose of this investigation was to determine whether a regular third grade class in a public elementary school could evidence satisfactory achievement in a beginning conversational French program, without adversely affecting achievement in the prescribed curriculum. It was hypothesized that:

1. A regular third grade class could evidence satisfactory progress in beginning conversational French, according to criteria set by their teachers and three French language specialists.
2. There would be no significant difference in achievement for the year in the prescribed curriculum between experimental groups studying French and equated control groups.

The research population consisted of 114 children in four third grade classes in two Metropolitan New York Schools. Each school had an experimental class which received aural-oral French instruction, and a control class which did not. The experimental and control groups were equated for age, intelligence and socio-economic status. The teachers in each school were equated in terms of training, experience, and their superiors' judgments of their ability. French instruction was carried on by the classroom teacher. The duration of the experiment was one school year.

Alternate forms of the Stanford Achievement Test were administered at the beginning and end of the year to determine the achievement gain for the year in the prescribed curriculum for all groups. Tape recordings of each child in unrehearsed conversation with the teacher

were employed by three French language specialists to evaluate French comprehension, fluency and pronunciation. The teachers' lesson plans, too, were evaluated by the specialists with respect to subject matter and coverage.

The findings were:

1. Both experimental groups made satisfactory progress in their French studies, according to judgments of the teachers and judges.
2. The pronunciation and fluency of the children in the experimental classes were considered by the judges to be superior to the results generally achieved with average high school students with an equivalent number of hours of instruction. However, performance in pronunciation, although generally at a higher level than that obtained with high school students, still indicated a wide range of ability.
3. Correlations between achievement in the prescribed curriculum and achievement in French yielded a high positive relationship (r = .81) in one experimental group, supporting reports of other investigators. However, in the other experimental group the r of .39, while positive, is relatively low.
4. The achievement tests revealed statistically significant differences in mean achievement gain for the year in favor of the experimental groups in Spelling and Arithmetic in one school, and in Arithmetic in the other school. In all other instances there were no statistically significant differences in achievement between experimental and control groups.

The following conclusions were drawn:

1. The findings indicate that children in a regular third grade class can evidence satisfactory achievement in beginning conversational French, thus supporting the theory of many language experts that this program need not be restricted to gifted children.
2. The opinion of the judges supports the theory that study of a foreign language in elementary school produces results in the spoken language superior to those obtained when the language is begun in high school. However, even among the elementary school children, performance in pronunciation revealed a wide range of ability.
3. The results indicate that there was no adverse effect on achievement in the prescribed curriculum by the introduction of the French program. On the contrary, the groups studying French evidenced greater achievement in seven out of eight instances, with the difference in mean achievement gain being statistically significant in three of these seven instances. In the judgment of the teachers and the investigator, the advantages in achievement evidenced by the experimental groups were due partially to their high motivational level.

Microfilm $2.75; Xerox $7.20. 155 pages.

A COMPARATIVE STUDY ON THE EFFECTIVENESS OF THE FILMSTRIP, SOUND FILMSTRIP, AND FILMOGRAPH FOR TEACHING FACTS AND CONCEPTS.

(Order No. Mic 61-1702)

Ronald James McBeath, Ph.D.
University of Southern California, 1961

Chairman: Professor Finn

The purpose of this study was to compare the relative effectiveness of a captioned filmstrip, a captioned filmstrip with narration, a sound filmstrip, and a filmograph in teaching facts and concepts. The filmograph is made by photographing still pictures on motion picture film, using such techniques as camera movement and pop-ons. The study attempted to verify the hypothesis that the filmograph could teach more effectively.

Survey of the literature disclosed no similar studies and pointed out that no definite conclusions had been made regarding general superiority of any one medium over another. From a population of 558 sixth-grade students in Los Angeles County, four matched groups of approximately the same size were formed. The students were matched on the basis of I.Q., age, sex, and socio-economic status.

Materials were produced with the same verbal and pictorial content, utilizing appropriate media differences such as type of narration, musical background, camera movement; and other filmic effects. A pilot study was conducted to refine testing instruments and procedures. The experiment was administered so that the students had the pretest, the presentation, and the posttest within an hour; retention tests were given three weeks later. Statistical analysis showed the groups were well matched and the tests sufficiently reliable to make a competent analysis of the results. Analysis of variance was conducted between the mean gains of the four media. Further analysis of significance was carried out by application of the Tukey test for significant gap between the rank-ordered media mean gains.

Findings. Immediate mean gains showed: (1) There was significant difference between the four media at the .05 level. The Tukey test on the rank-ordered means, however, revealed that no one method could be considered significantly superior or inferior. (2) The boys did significantly better than the girls at the .01 level. (3) Students with higher intelligence quotients did significantly better than those with lower intelligence quotients at the .05 level.

Retention mean gains showed: (1) There was no significant difference between the four media. (2) The boys were significantly better than the girls at the .01 level. (3) The students with higher intelligence quotients did significantly better than those with lower intelligence quotients at the .05 level.

Conclusions and Recommendations. The hypothesis that the filmograph can teach better than the filmstrip is rejected. Results showed that matched groups of sixth-grade students could learn facts and concepts equally well from all of the four media. It would appear from this study that such media differences as type of narration, musical background, camera movement, and other filmic techniques have no measurable effect on learning. However, it should

be remembered that the specific media differences were not separated out for testing purposes and that the study was between total media. It is difficult to conclude how much of the learning in the study may have been influenced by such factors as motivation from the content, presence of a stranger in the room, interest in special activity, or competitiveness of an experimental situation. These conclusions apply to this particular study and the situation in which it took place. The findings tend to support the research regarding media effectiveness.

Perhaps the most pressing need is the development of new types of testing devices, since paper-and-pencil tests may possibly limit response levels after a visual and auditory presentation. Because quantity and quality are continually sought in education, further experimentation of a more specific nature should be conducted so that instructional techniques using audio-visual media can be improved.

Note: The research reported herein was supported by a grant from the United States Office of Education, Department of Health, Education, and Welfare.

Microfilm $2.75; Xerox $6.80. 144 pages.

A STUDY OF THE EFFECTIVENESS OF THE KUDER PREFERENCE RECORD-VOCATIONAL IN DISCRIMINATING AMONG PURDUE ENGINEERING GRADUATES

(Order No. Mic 61-2489)

Daniel Morris McMillen, Ph.D.
Purdue University, 1961

Major Professor: Lee E. Isaacson

The engineer is a necessary component in our society. Any information concerning his effectiveness in training, his choice of curriculum, and his eventual occupational function is desirable for those responsible for his guidance and education. In essence these were the primary factors under surveillance in this investigation. They were considered with respect to the application of the Kuder Preference Record Form B. This inventory has subsequently evolved into the Kuder Preference Record-Vocational Form C.

The Kuder-Vocational was administered to all students entering Purdue University between the years of 1947 and 1951. These data were received and coordinated with information concerning occupational functions taken from an extensive study of Purdue engineering graduates conducted in 1957. This study included twenty-five per cent of the engineers who matriculated during the interim in which the Kuder-Vocational was a part of the freshman test battery. The Alumni Office provided information pertaining to the criterion of graduation and to the establishment of the curriculum of graduation of those entering Purdue in the aforementioned period.

Four hypotheses were tested. Each considered the effectiveness of the individual Kuder-Vocational scale in discriminating among groups of engineering students and of graduate engineers.

It was found that seven of the nine Kuder-Vocational scales were able to distinguish among groups of engineering students segregated as follows: (1. Those who entered and completed an engineering curriculum (n = 3,815). (2. Those who entered engineering but graduated from another school within the university (n = 644). (3. Those who entered another school within Purdue but graduated from a curriculum in engineering (n = 69). And (4. Those who entered engineering training but did not graduate from Purdue (n = 2,620). The mean differences found between groups were numerically small, but statistically significant. The literary and musical scales produced data which did not result in significant differences among groups.

All of the Kuder-Vocational scales differentiated among the engineering graduates segregated by curriculum of graduation. There were 3,884 graduates in this sample. Nine engineering curricula were offered at Purdue at the time of this study. The clerical scale data produced differences among groups significant beyond the .05 level, while the remaining scales differentiated beyond the .01 level of significance. The scientific scale was the most effective scale in discriminating among the curriculum groups.

There were sixteen occupational functions considered in the third hypothesis. These were established and defined by the study made of Purdue engineering graduates in 1957. The data for 663 men whose occupational function was known were analyzed. It was found that the scientific and persuasive scales could differentiate among the functional groups beyond the .01 level and the computational and artistic scales were able to differentiate beyond the .05 level of significance. Differences among group means on the remaining scales were not statistically significant. The scientific scale was the most sensitive to group differences.

Curriculum by function groupings of the 663 men produced significant differences among means on all of the scales. The scientific scale again appeared to be most capable of differentiating among groups, while the social service scale was the least effective. Differences occurred beyond the .01 level of significance for all scales.

It was concluded that the Kuder Preference Record-Vocational was able to distinguish between successful and unsuccessful engineering students; however the differences found in this study were numerically small. The instrument was much more adequate in differentiating among engineering graduates grouped according to their curriculum of graduation. The use of the Kuder-Vocational to this end would be much more effective. Certainly engineering graduates have many occupational functions from which to choose, and their interests measured at the beginning of training appeared to be related to these eventual functions.

Microfilm $2.75; Xerox $7.00. 146 pages.

A COMPARATIVE STUDY OF SELF-PERCEPTIONS OF AGGRESSIVE AND WITHDRAWN CHILDREN

(Order No. Mic 61-2251)

Esther Marguerite Morgan, Ed.D.
The University of Florida, 1961

This research sought to explore the hypothesis that aggressive children see themselves as more adequate than withdrawn children; i.e., that aggressive children have self concepts that reveal greater feelings of adequacy than withdrawn children. Secondary questions explored were: (1) What is the nature of the self concepts of aggressive and withdrawn children? (2) How do aggressive and withdrawn children compare on measurements of both full scale and performance intelligence?

Fifteen aggressive and fifteen withdrawn children, selected from four hundred sixty-five referred for psychological evaluation, comprised the sample. Behavioral criteria were developed for identifying (1) aggressive children and (2) withdrawn children. Each child included in a particular group demonstrated evidence of all the behavioral criteria for that group and none of the behavioral criteria of the opposite category. The selection technique was validated by submitting all the behavioral data to two other psychologists who considered the data independently and judged for the presence or absence of each of criteria used in classifying the children as aggressive or withdrawn.

The self concepts of the children were explored both quantitatively and qualitatively. Standard clinical procedure was used in gathering the data upon which the inferences were made. The instruments used included questionnaires, the Wechsler Intelligence Scale for Children, and the following projective instruments: Bender Visual Motor Gestalt Test, Buck's House-Tree-Person Test, and Combs Picture Story Test (Short Form). Quantitative self concept scores were obtained through the use of two score sheets: (1) Combs Picture Story Test (Short Form) Score Sheet and (2) Combs and Soper Self Perception Rating Scale. Two procedures were followed to test the reliability of the quantitative assessments: (1) self reliability and (2) reliability checked against other judges.

The qualitative phase of the study was undertaken to explore more freely, albeit not so mathematically, the nature of the perceptions of aggressive and withdrawn children. Narrative descriptions of the inferred self concepts were prepared and an attempt was made to identify for each child (1) the basic perceptions making up the core of the phenomenal self, the self concept; and (2) the less basic perceptions making up the periphery of the phenomenal self.

The hypotheses that aggressive children have higher full scale intelligence than withdrawn children and that withdrawn children have higher performance intelligence than aggressive children were not confirmed. The differences between the two groups, in both cases, were found to be statistically insignificant. The following hypotheses concerning self concept scores on the two score sheets were confirmed:

1. Combs Picture Story Test (Short Form) Score Sheet

   Total self concept scores and subscores dealing with the way child sees himself (a) in relation to dealing with persons (items 1-6) and (b) in relation to school situations (items 8-12) were statistically higher for aggressive children.

2. Self Perception Rating Scale

   Total self concept scores and subscore dealing with how the child sees himself in generally adequate or inadequate ways, in essentially positive or negative ways, as an instrument for accomplishing his own ends and in interaction with other people, including his peers but not his teachers (items 1-11), were statistically higher for aggressive children.

The analyses of the narrative descriptions of the inferred self concepts added further confirmation to the quantitative evidence that aggressive children see themselves as more adequate than withdrawn children. The most significantly different perception identified in the self concepts of the aggressive children as compared with the withdrawn children is seeing oneself as able to assert oneself. The most significantly different perception identified in the self concepts of the withdrawn children is seeing oneself as unable to cope with people.

Microfilm $2.85; Xerox $9.90. 219 pages.

DEVELOPMENT OF THE SITUATIONAL RESPONSE TEST OF MARITAL INTERACTION AND ADJUSTMENT

(Order No. Mic 61-1971)

Owen W. Morgan, Ph.D.
The University of Nebraska, 1961

Adviser: Charles O. Neidt

The twofold purpose of this study was to (a) develop an indirect-type test of marital adjustment and interaction and to compare its effectiveness with a more direct-type test and (b) to analyze the contribution of six different dimensions of marital interaction to the performance of the indirect test. The six dimensions were: affection, affirmation, agreement, communication, companionship, and consideration.

A Situation-Response Test of Marital Interaction and Adjustment (SRT) was developed. Forty-one items representing life-like situations in six areas of marital interaction were chosen on the basis of an item analysis and were assigned to dimensions by a panel of judges as well as internal consistency indices.

The Situational-Response Test and the Locke Test of Marital Adjustment were each administered to criterion groups representing three levels of marital adjustment. Independent criteria of (a) college students' ratings of their parents' marital happiness and (b) cases designated by marriage counselors were used in identifying the three groups of subjects. The sample included a total of 126 subjects: 55 in the "happy group," 34 in the "middle group," and 37 in the "unhappy group."

Reliability of the tests was demonstrated both by test-retest and the Spearman-Brown split-half reliability procedures. The reliability coefficients for each of the tests ranged from .89 to .92 both for the test-retest and the split-half analyses.

Validity of the instruments was established by means of (a) analysis of variance of the significance of differences between the distributions of scores of subjects in the three groups and (b) biserial correlation analysis of the relationship between scores on the two tests with the happy and unhappy groups. In applying the biserial correlation analysis to the SRT, discriminant analysis was included in order to take advantage of the maximum contributions of each subtest or dimension.

Two hypotheses were postulated: (a) that the indirect SRT would be more effective in discriminating among the criterion groups than would the direct Locke test and (b) that the dimensions of communication and companionship would be more effective than the others in contributing to discrimination between or among the groups. Neither hypothesis was specifically supported by results of the study. Only in comparisons including the high end of the marital adjustment continuum did the SRT prove to have an advantage over the Locke test.

The second hypothesis also was not supported by results of the study. The dimension of agreement ranked first in the extent to which the subtests discriminated between marital adjustment groups. Communication and companionship, however, were at or above the median discrimination rank among the subtests in both instances.

Tentative conclusions were reached that (a) the SRT warrants further investigation especially for purposes of discriminating among subjects at the upper end of the marital adjustment continuum and (b) that the dimension of agreement and those of communication and companionship surpassed the other three in power to discriminate among happy and unhappy groups.

The need for further study both of indirect approaches to the assessment of marital adjustment and of dimensions of marital interaction was cited.

Microfilm $2.75; Xerox $6.40. 134 pages.

A STUDY OF PERSONNEL DATA AS PREDICTORS OF BEHAVIOR OF TRANSFER STUDENTS AT THE UNIVERSITY OF COLORADO

(Order No. Mic 61-837)

Richard Lawrence Nash, Ed.D.
University of Colorado, 1960

Supervisor: Professor Richard Fox

The problems. The first problem was to determine if there was a greater incidence of social problems among transfer than among regular students at the University of Colorado. The second problem was to determine if the incidence of social and academic problems of transfer students could be predicted from the records obtained from the institutions they had previously attended.

Procedures. Data were collected on transfer students from four-year colleges and universities, transfer students from junior colleges, and regular students who had matriculated as beginning freshmen at the University of Colorado. The students in the three samplings were then rated as social problem or non-social problem students by the counselors, housemothers, and landladies of the students. Each student also was classified according to his grade point average for the fall semester of 1957. The percentages of social problem students of the regular, transfer, and junior college transfer samplings were compared to each other, and comparisons were made within the following sub-groups: sex, class, residence, and colleges within the University. The percentages of academic problem students of the three samplings were compared to each other according to sex. The relationship of social and non-social problem students to academic problem students was then studied. The obtained differences between percentages of social problem students and between percentages of academic problem students in the samplings and sub-groups were tested for statistical significance.

The second problem in the study was to determine if the ratings obtained from information on the University of Colorado's Transfer Application Part II form agreed with the known social and academic ratings of the students. The transfer personal data forms which had been completed by the transfer students' former colleges and universities, were rated by three members of the Office of Admissions and Records. Then, the percentages of agreement were determined between the social and academic ratings as determined from the transfer personal data sheets and the social and academic ratings indicated by the counselors, housemothers, and landladies and grade point averages, respectively.

Conclusions. The following conclusions are based on the finding of this investigation:

1. Transfer students had no greater percentage of social problem students than the regular students.
2. Junior college transfer students had no greater percentage of social problem students than the regular students.
3. Transfer students had no greater percentage of social problem students than the junior college transfer students.
4. Junior college transfer college residence students had a significantly greater percentage of social problem students than the junior college transfer non-college residence students.
5. Regular college residence men and regular college residence women had significantly greater percentages of social problem students than the regular non-college residence men and the regular non-college residence women, respectively.
6. Junior college transfer students had a significantly greater percentage of academic problem students than the regular or transfer students.
7. Transfer students had no greater percentage of academic problem students than the regular students.
8. Regular and transfer men had significantly greater percentages of academic problem students than the regular and transfer women, respectively.
9. Regular and transfer social problem students had significantly greater percentages of academic problem students than the regular and transfer non-social problem students, respectively.
10. Junior college transfer social problem students had no greater percentage of academic problem students than the junior college transfer non-social problem students.
11. Transfer personal data sheets detected 16 per cent of the students who turned out to be social problem students.

12. Transfer personal data sheets detected 21 per cent of the students who were academic problem students. Microfilm $2.75; Xerox $8.20. 180 pages.

THE EFFECTS ON NON-TARGET CLASSMATES OF TEACHERS' EFFORTS TO CONTROL DEVIANT BEHAVIOR

(Order No. Mic 61-2338)

Leon T. Ofchus, Ph.D.
Wayne State University, 1960

Adviser: Jacob S. Kounin

One hundred and twenty-five students of selected Detroit Public high schools were interviewed during their first two weeks as tenth grade students. Each student described two incidents involving a teacher attempting to control misbehavior. One of those incidents occurred in a class in which the subject was higher in motivation to learn and the other incident occurred in a class in which the subject was lower in motivation to learn. Students also responded to open-ended and forced choice questions designed to elicit their judgments about and reactions to the incidents observed by them.

Codes were developed to analyze the data found in the description of the incident and the judgments about the incident.

Qualities conceptualized from the description of the incidents involving the teachers' attempts to control misbehavior and the students' responses to certain forced choice questions were treated as three sets of variables; control technique properties, event-based judgments, and reactions to the event. These variables were first analyzed according to the frequency and per cent of their incidence.

The incidence of the above variables was also analyzed in terms of the influence of each of these prevailing variables; the subjects' motivation to learn, the subjects' liking for the teacher, and the subjects' judgment of the teachers' competency. The Chi Square test was the statistical test used to determine the significance of findings.

Independent of the prevailing variables specific control technique qualities were related to certain student reactions to the event. Student judgments about the event were then related to student reactions to the event.

Under each of the three prevailing variables, control technique properties were related to event-based judgments and reactions to the event. Then, event-based judgments were related to reactions to the event.

Statistically significant relationships were found between certain control technique properties and certain student judgments about the event. Specific student judgments were found related to specific student reactions. Each of the three prevailing variables were found to exert a statistically significant effort upon the interrelationships among the control technique, student judgment and student reaction variables.

Implications for teachers of these findings were reported. Microfilm $4.95; Xerox $17.35. 385 pages.

AN ANALYSIS OF THE APPLICATION OF UTILITY THEORY TO THE DEVELOPMENT OF TWO-STAGE TESTING MODELS

(Order No. Mic 61-2114)

John H. Rosenbach, Ed.D.
The University of Buffalo, 1961

The purpose of this study is to examine some of the possible applications of utility theory to the development of two-stage testing models, and, more specifically, to consider two basic questions: (1) under what conditions is sequential testing more efficient than single-stage testing, and (2) can systematic procedures be developed which will enable a test user to select a sequential testing plan (strategy) which, for a given set of data, will result in maximum efficiency (utility)?

Utility theory and sequential testing.--Utility theory, which evolved from mathematical game theory, has been developed most comprehensively by Cronbach and Gleser[1]. These authors define utility as the benefits which accrue from a set of decisions less the cost of gathering the data on which the decisions are based, and suggest that this approach to the evaluation of tests represents a much more realistic appraisal of the value of tests to the user than do the more traditional devices, such as the index of forecasting efficiency, the coefficient of alienation, or the coefficient of determination.

Research in areas other than education indicates that sequential testing plans result in considerable savings in costs as contrasted to single-stage models; and with educational institutions relying more heavily on tests each year it seems logical that steps be taken to investigate the possibilities of incorporating such sequential procedures in these testing programs.

The two-stage model described in this study consists of an inexpensive initial test which furnishes a single score on the basis of which three decisions, related to the second or criterion test – a lengthy expensive instrument – may be made: to "accept" the subject, to "reject" the subject, or to require the subject to be tested on the criterion stage. These three decisions depend on whether the initial test score falls above, below, or within certain designated cut-off scores.

Utility of single-stage and sequential plans.--To determine under what conditions sequential testing plans result in greater utility than single-stage plans, formulas for the utility of each procedure are derived from the basic utility formula (U=B-L-C). These are then stated in the form of the inequality, Useq is greater than U_1, and reduced to simplest terms. The components which remain indicate that a sequential strategy is admissible (i.e., results in greater utility than a single testing procedure) when, through use of the sequential model, the reduction in costs exceeds the net loss in benefits.

Optimum utility of sequential strategies.--Theoretically, optimum utility of any selection problem can be determined by varying the cutting scores on the initial test, so that the difference between the savings in costs and the loss in benefits is at a maximum. Various attempts have been made to derive indices of optimum utility which would be comparable across tests, but as yet only indirect solutions have been developed.

In this study, empirical or inspectional procedures are suggested through which the decision-maker can select a limited number of strategies, each of which appears to be a likely solution and then determine the strategy which results in greatest utility by comparing the outcomes under each strategy.

Examples of this approach, utilizing scores obtained from the Otis Gamma (initial stage) and subtests of the Differential Aptitude Test (criterion) are presented, although certain assumptions are made which tend to simplify the problems which would ordinarily confront a decision-maker in an applied setting. Since the suggested procedures are not mathematically precise, it is not possible to make any definitive statements regarding optimum utility; however, the results are favorable to the extent that the procedures employed demonstrate the feasibility of eliminating a substantial number of subjects on the basis of initial test scores with only a relatively small proportion of incorrect decisions.

A major assumption regarding the ability of a decision-maker to assign values to decision outcomes on the same dimension as testing costs is basic to the entire study. This problem of scaling objectives, aims, and values is one which must be solved before it will be possible to apply utility theory, at least to any great extent, to decision-making problems in education.

1. Lee J. Cronbach and Goldine C. Gleser, Psychological Tests and Personnel Decisions, (Urbana, Ill.: University of Illinois Press, 1957)

Microfilm $2.75; Xerox $4.20. 78 pages.

A COMPARATIVE INVESTIGATION OF THE PERFORMANCE OF MENTALLY RETARDED AND INTELLECTUALLY NORMAL BOYS ON SELECTED READING COMPREHENSION AND PERFORMANCE TASKS

(Order No. Mic 61-1501)

Andrew Luther Shotick, Ph.D.
Syracuse University, 1960

Supervisor: William M. Cruickshank

The purpose of this investigation was to compare the performance of mentally retarded and normal subjects on selected reading comprehension and related performance tasks.

The IQ's of the retarded group ranged from 61-76 with a mean IQ of 68.45. IQ's of the normal group ranged from 94-107 with a mean IQ of 99.36. The subjects were matched individually on the basis of mental age (retarded mean mental age 105.36 months, normal mean mental age 104.95 months), reading age (retarded mean reading age 104.27 months, normal mean reading age 104.73 months), socio-economic status, visual perceptual difficulties, race, and sex.

Reading comprehension tasks selected included: (1) Utilization of Context Clues, (2) Interpretation of Figurative Language, (3) Locating Factual Information, (4) Selecting the Main Idea, (5) Sequential Ordering, and (6) Classifying and Indexing Ideas. Performance tasks included: (1) Object Assembly, (2) Picture Arrangement, (3) Picture Completion (Performance Tasks 1, 2, and 3 all from Wechsler Intelligence Scale for Children), (4) Stencil Design Test, (5) Healy Picture Completion Test, II (the latter two tasks from the Arthur Point Scale of Performance Tests, II), (6) Analogous Progression Series, and (7) items designated Classifying Series by the writer (the latter two tasks from the Leiter International Performance Scale).

Statistical analysis by t ratio indicated a significantly superior performance by the normal group on each reading task but no significant differences between the normal and the retarded groups on any performance task.

Evidence from the present investigation and from past research seems to justify the conclusions that the reading tasks may involve the psychological variables of production and evaluation which are influenced by extraneous information in retarded subjects. Limitations were discussed and possibilities for further research were suggested. Microfilm $2.75; Xerox $7.60. 163 pages.

THE RELATIONSHIP BETWEEN SCORES ON THE STRONG VOCATIONAL INTEREST BLANK AND ACADEMIC PERFORMANCE AT THE STATE UNIVERSITY OF NEW YORK COLLEGE OF MEDICINE AT SYRACUSE

(Order No. Mic 61-1502)

Stuart Elwood Smith, Ed.D.
Syracuse University, 1960

Supervisor: W. A. Berg

Objectives of the Study. The first objective of this study was to determine the relationship between Strong Vocational Interest Blank scores and academic performance in the State University of New York College of Medicine in Syracuse. The second objective was actually threefold. The three sub-objectives, stated in question form, were:

1. As a matter of general information concerning the SVIB, how similar are the intercorrelations obtained from a recent, homogeneous sample of first-year medical school students to the original intercorrelations obtained from a heterogeneous sample of Stanford University seniors of 1927?
2. To what extent does the veterinarian key correlate with the other SVIB keys, and particularly those keys in Group I?
3. To what extent does the osteopath key correlate with the other SVIB keys, and particularly those keys in Group I?

The third objective was to determine the frequency of occurrence of primary and secondary interest patterns in Group I and Group II for the writer's sample of medical students.

Procedures. The male members of the classes entering the College of Medicine in 1953, 1954, 1955, and 1956 constituted a sample numbering 280 cases.

In this study, as a necessary preliminary step, the relationships between certain cognitive variables and achievement were determined. These relationships were expressed

in terms of product-moment correlations between the cognitive predictor variables and grade-point-average in medical school. These procedures permitted the factor of scholastic aptitude to be controlled.

Three approaches pursuant to the first objective of the study were utilized:

1. One way in which the relationship between the SVIB and medical school achievement was investigated was through the means of correlational analysis. Product-moment correlations were computed between each of the SVIB keys and the various academic criteria (grade-point-averages).

2. Darley's pattern analysis technique was the second type of SVIB analysis. Three groups of students, over achievers, normal achievers, and under achievers, were compared according to the incidence of primary and secondary interest patterns in Group I and Group II.

3. A profile method constituted the third type of analysis which was employed in reference to the first objective. Scoring weights were assigned to each of the 47 SVIB keys. The weights were chosen to maximize the differences among the three groups, over achievers, normal achievers, and under achievers. Using this method, three special scoring keys were developed, one for each of the three groups. The results obtained by the special keys were analyzed to see if individual over, normal, and under achievers were differentiated on the basis of their SVIB profile scores.

The second objective centered upon the statistical bases for grouping various keys into families. For two medical school classes, product-moment intercorrelations were computed among all the SVIB keys.

In reference to the third objective of the study, the incidence of primary and secondary interest patterns in Group I and Group II was determined for the four classes combined, without regard to scholastic achievement.

Main Conclusions

1. Interest, as measured by the separate SVIB keys, was not related to the academic achievement of medical students when scholastic aptitude was not controlled.

2. Over, normal and under achievers obtained approximately the same percentages of interest patterns in Group I and Group II, even though scholastic aptitude was controlled.

3. Over, normal and under achievers were found to have distinctively different SVIB scores when a special profile scoring technique was employed.

4. The evidence indicated that the osteopath and veterinarian keys are improperly placed in Group I, at least from the standpoint of a medical school population.

5. Of 277 first-year medical students, 40 per cent had neither a primary nor a secondary interest pattern in Group I.

Microfilm $2.95; Xerox $10.35. 226 pages.

THE CONSTRUCTION AND VALIDATION OF A TEST OF TEN TEACHER SKILLS USED IN READING INSTRUCTION, GRADES 2–5.

(Order No. Mic 60-6071)

Eugene Wellington Wade, Ed.D.
Indiana University, 1960

Chairman: Nicholas A. Fattu

Valid and reliable tests capable of measuring teacher skills involved in elementary school instruction would have many uses. The tests could be used to hire skillful teachers, select the less skillful for in-service training, serve as pre-test and post-test measures in experimental work; and, most important, they could be used to study the variables which affect the acquisition of teaching skills.

Of the ten problems six are tape recordings of children reading from various books. The teacher's skills are measured by the correctness of her judgments about each child's reading abilities. The remaining four problems are the paper-and-pencil type. High scoring teachers are those who are skillful in selecting books of the proper level of difficulty, placing children into homogeneous reading groups, judging the amount of reading gains that pupils achieved after classroom instruction, diagnosing specific reading skill deficiencies, diagnosing and correcting phonic and syllabication errors, organizing into meaningful instructional categories a child's word perception errors and recognizing the goals of various kinds of reading workbook exercises.

The validation of the test was done in two ways. First, it was reasoned that if teaching skills are learned from experience then test performance should increase as a function of the years in the classroom. This was tested by cross-sectional comparisons of criterion groups differing in amount of teaching experience. It was predicted that college undergraduates in the School of Education, Indiana University, would score lowest; practice teachers with sixteen weeks of experience from the same institution were predicted to score significantly higher; and a sample of the teaching population, grades two through five, was expected to significantly outscore both groups. Within the teacher groups, test performance was expected to be a function of experience.

The second validating procedure used was the criterion of pupil gain. It was predicted that those teachers who score in the top quartile of the teacher distribution should produce significantly greater reading achievement gains in their pupils than will the bottom quartile scoring teachers.

In addition to validation, item and subtest analyses were made; the split-half reliability was determined; and a factor analysis was computed.

Findings: On the gain-with-experience criterion it was found that the two teacher samples combined, (n=176) significantly outscored the practice teachers (n=89), who in turn significantly outscored the undergraduates (n=97). Within the teacher sample the prediction of test performance as a function of experience was verified.

On the pupil gain criterion the prediction was verified; that is, the effects that the teachers produced were related to their performance on the reading-problems test.

The item and subtest analyses indicate that the test is suitable for use without further revision. The split-half reliability was found to be .87. The factor analysis yielded four factors.

The reading-problems test and the Intermediate Grade Mathematic Teaching Tasks by R. L. Turner and N. A. Fattu are available for use through the Institute of Educational Research, Indiana University. For a more complete report the reader is referred to the following publications:

Turner, R. L., Problem Solving Proficiency Among Elementary School Teachers, II, Teachers of Arithmetic Grades 3–6, Monograph of the Institute of Educational Research, Indiana University, Bloomington, August, 1960.

Wade, E. W., Problem Solving Proficiency Among Elementary School Teachers, III, Teachers of Reading Grades 2–5, Monograph of the Institute of Educational Research, Indiana University, Bloomington, August, 1960.

Microfilm $2.75; Xerox $4.80; 91 pages.

A STUDY OF THE EFFECT OF MUSIC AS A DISTRACTOR ON THE MENTAL TEST PERFORMANCE OF CERTAIN ELEVENTH GRADE STUDENTS

(Order No. Mic 61-2728)

Thomas B. Williams, Ed.D.
Temple University, 1961

The purpose of this study was to determine the effect of musical distraction on the mental test performance of certain eleventh grade students.

The need for this study is evident in the literature on the effect of music in industry, on reading, and on test performance. This information revealed that conclusions were contradictory and uncertain.

The subjects (250) were certain high school juniors. Control and Experimental groups were used. The groups were matched as to age, sex, program, and ability. The testing instrument was three forms of the American Council on Education High School Psychological Examination. The control group was tested under ideal conditions during each administration. The test conditions for the experimental group were as follows: (1) ideal; (2) distracted by popular music; (3) distracted by classical music. The data was organized into boys control, boys experimental, girls control, girls experimental and certain attitude groups to enable comparisons. Means, standard deviations, critical ratios and correlations were computed.

The administration of the ACE Form 1953 (ideal conditions for both groups) revealed that there were no significant differences between the means of the test scores of any of the established groups.

The administration of the ACE Form 1948 (ideal conditions for the control group, and popular music as a distractor for the experimental group) revealed that for the control and experimental groups a significant difference occurred between the means of the Q-scores. There was no significant difference between the means of the L-scores or the T-scores. For the upper half of the control and experimental groups, a significant difference occurred between the means of the Q-scores and the T-scores, but not between the means of the L-scores. For the lower half of the control and experimental groups, no significant differences occurred.

The administration of the ACE Form 1947 (ideal conditions for the control group and classical music as a distractor for the experimental group) revealed that there were no significant differences between the means of the test scores of any of the established groups.

The questionnaire which was administered to all subjects reported that test scores were inconsistent with the subjects' stated attitudes concerning their own distractability.

The comparison of the test scores between boys and between girls showed that boys were adversely affected to a significant degree by popular music, but girls were not so affected.

The extent and pattern of the correlations of the test scores were similar for all groups. The variance of the control and experimental groups tended to remain the same with the single exception being the boys' experimental group whose variance changed significantly on Q-scores when popular music was played.

Most students in the control and experimental groups increased their scores on each successive administration of the ACE except for the experimental group when popular music was played.

Within the framework of this study the following conclusions may be presented:

1. Popular music adversely affects mental test performance when tasks involve quantitative ability.
2. Popular music does not affect mental test performance when tasks involve linguistic ability.
3. Popular music adversely affects the mental test performance of students of average and above average academic rank more than those of lower academic rank.
4. Popular music adversely affects the mental test performance of boys more than that of girls.
5. Classical music does not affect mental test performance.
6. Stated attitudes concerning distractibility are inconsistent with actual mental test performance.
7. Relative position in the group is not affected by music in the case of girls, but is somewhat affected by popular music in the case of boys.

Microfilm $2.75; Xerox $7.00. 150 pages.

EDUCATION, RELIGION

AN INVESTIGATION OF THE TRAINING NEEDS OF LAY RELIGIOUS EDUCATORS IN CONSERVATIVE BAPTIST CHURCHES IN SOUTHERN MICHIGAN

(Order No. Mic 61-2333)

David E. Gillespie, Ed.D.
Wayne State University, 1960

Adviser: Dr. Harold O. Soderquist

This investigation involved the securing by detailed personally group administered questionnaire from 300 active lay religious educators chiefly serving in 16 Conservative Baptist Churches in Southern Michigan--church school teachers, administrators, youth group leaders and sponsors, etc., comprising from each church a group of non-professional lay workers--information indicative of some of their individual training needs. In addition, replies from the lay teaching staff of a Free Methodist Church were included for purposes of comparison, as were the replies from the pastors of each of the churches.

This investigation sought to ascertain:

1. Who are these lay religious educators? (Sex, age group, children, years of experience, if any, as a secular teacher and also as a lay religious educator, secular occupation and educational status.)
2. What do they know? (Concerning biblical content in historical framework, the development of Christianity, and the theory of religion and religious education.)
3. What do they feel the need to know? (Concerning the Bible, the development of Christianity, the needs of the students with whom they work, "the how" of teaching and supervision and administration in religious education.)
4. What do they suggest to meet their need to know? (Concerning an in-service training curriculum and accompanying laboratory experience in supervised "on the job" training.)

The results revealed that the individuals investigated scored considerably less than the minimal acceptable score set previously by the Education Committee of the Conservative Baptist Association of Michigan through whose co-operation this study was made. While great individual disparity was evident, average scores indicated highest knowledge to be possessed in biblical content in historical framework, then in the development of Christianity, and lowest scores in the theory of religion and religious education.

Two causes are found for the possession of religious content-knowledge, first and foremost the individuals' amount of formal education, and second, his years of experience as a religious educator before the age of 40.

The chief cause of lack of religious content-knowledge is lack of sufficient general knowledge education (four years or more) on the intellectual level of college study. The second cause is lack of religious technical education on a post high school or post college level.

Other causal factors are lack of sufficient growth as a teacher and/or administrator "on the job," including definite regression in knowledge possession after one is 40; the lack of an adequate philosophy of religious education; the lack of administrative provision of vital encouragements, challenges, and supervisory aids to local church teaching staffs and the lack of provision of any adequate in-service training programs.

Persons who possessed four years or more of general knowledge college study not related to religion scored higher than persons with three years or less of specific study in Bible and cognate fields pursued in a Bible institute.

The suggestions of the individuals investigated for an in-service training program and for laboratory experience and "on the job" training were found to be not consonant with their revealed knowledge and expressed needs.

Suggestions for such an adequate program for local churches to train their teaching personnel are made by the investigator. He also suggests that Master Teachers, fitted to train other teachers (three persons, including the pastor from each local church) be trained by Wayne State University as a public service. He makes suggestions for curricula to be offered Master Teachers which he feels can be functionally, and not theologically, presented and in no sense violate the principle of separation of church and state.

The investigator also offers original suggestions for an adequate sociological definition of religion and also for an adequate psychological statement of why men religiously learn best. Microfilm $4.95; Xerox $17.55. 386 pages.

EDUCATION, TEACHER TRAINING

TEACHERS IN THE BECOMING: A CASE STUDY OF AN INITIAL PROFESSIONAL EXPERIENCE FOR PROSPECTIVE ELEMENTARY SCHOOL TEACHERS.

(Order No. Mic 61-2321)

Arthur Thomas Allen, Ed.D.
Wayne State University, 1960

Adviser: Ruth Ellsworth

An attempt was made in this study to create a new design for a basic professional introductory course at Wayne State University for prospective elementary school teachers, to develop such a course with a group of students, and to evaluate it. The purpose of the study was to provide opportunities for students to recognize the major functions performed by the classroom teacher as he fulfills his professional role, and to recognize guiding principles of teaching and learning within which he may develop his professional behavior. The investigator envisioned a program which would build upon understandings of children and youth previously gained in the pre-teaching activities in the one hundred hour group work program at Wayne State University by means of wide and varied participation-observation experiences aimed at initiating the student into the profession of teaching.

Twenty-six students majoring in elementary education were enrolled in this new professional introductory course. They represented a cross section of the junior class in diversity of experience, background, age, academic performance, race, and nationality.

Methods germane to action research were employed for the collection of data. These included: recorded observation of student behaviors in initial student teaching situations; interviews with students, teachers, principals, and administrators; analysis of written logs, papers, and teaching plans; analysis of written evaluations of student teachers made by college supervisors; questionnaires; student opinionnaires; examination of student cumulative records; analysis of a tape-recorded evaluation session; and use of the Minnesota Teacher Attitude Inventory.

The cooperating principal was given the primary role of directing learning experiences for students during the initial stages of the program in the public schools. The evidence gained in this study supports other recommendations that principals can and should be an integral part of the professional team in teacher education.

Experiences of the students in this study included participation activities, observations, and exploratory teaching which they recorded on a Laboratory Experience Record prepared by the investigator. The students' findings as a result of these experiences revealed that the teacher functions as:

1. a classroom administrator
2. a facilitator of good human relations
3. an educational diagnostician
4. a guide in the learning process
5. a responsible contributing member of the profession.

Evidence was gained to support the fact that this type of experience enabled these beginners to identify the professional role of the teacher including the specific jobs of the classroom teacher. From this knowledge of role they were able to formulate professional goals for which to strive.

To assist students in identifying and intellectualizing basic principles of learning, the investigator employed Corey's five summary statements on points of view in learning. Seminar sessions and directed observations were provided to help students recognize, intellectualize, and utilize these principles on an exploratory level in student teaching.

Evidence from cooperating teachers, principals, and college supervisors indicates that this program helped students in varying degrees to focus on children and to apply a methodology based on what they knew about how children learned in the particular communities in which they were working. The fact that students first viewed the school as a whole seemed to have many learning advantages for the prospective elementary school teachers involved in this study.

Evaluative comments from professional workers cooperating in the study pointed out that this particular program had certain apparent strengths for juniors in their first semester in the College of Education. Those evidences most often cited were the gradual induction of students into the profession, the fine professional point of view exhibited by individual students as well as by the group, and the ability of students to first focus on the learner for educational direction before developing any kind of a learning experience.

Microfilm $2.95; Xerox $10.35. 226 pages.

THE LEARNER IN TEACHER EDUCATION: A STUDY OF SELECTED ASPECTS OF VALUES.

(Order No. Mic 61-2336)

Bruce R. Joyce, Ed.D.
Wayne State University, 1960

The subjects of this study were undergraduate students in elementary-school teacher education at Wayne State University. In order to gather information on which to base future action research into ways of improving students' value development, five aspects of these students were studied. Previous research had indicated that few schools of education have appreciable effect on the values of their students.

Findings and conclusions included the following:

1. A questionnaire administered to 385 students revealed that they represented all social backgrounds. Many students appeared to be upwardly mobile by means of education. Many of them lived busy, fragmented lives which included demands from work and marriage as well as college. They belonged to many social groups within and without the university and tended to retain home and neighborhood contacts throughout college.

2. Inventories administered to 157 students revealed relatively high religious interests and relatively low political and economic interests. Students showed relatively little concern with social and philosophical issues and they generally manifested the "privatism" which other investigators have reported is characteristic of the American college student.

3. An inventory designed to investigate educational viewpoints was administered to 106 students entering and 93 students graduating from the College of Education. The beginning students responded to the inventory much as did the graduating students. Both groups accepted "child" and "community-centered" philosophies and tended to reject an "academic" view. However, students appeared to have confused and conflicting philosophies. Many at both levels accepted contradictory positions and rejected statements which seem logically dependent on others they had accepted. Graduating students were nearly as inconsistent as were beginning students.

4. Twenty students were interviewed at length and asked to speculate about the educational views of their associates, their college instructors, and their cooperating teachers. They perceived many cooperating teachers as much more "academic" and "tradition"-centered than college instructors, particularly in regard to practical classroom matters. Education students were perceived to hold views similar to those of the instructors. Relatives and neighborhood friends were perceived to hold views similar to those of cooperating teachers. Some individual students perceived strongly-conflicting educational views among their associates, particularly between their cooperating teachers and college instructors. Some reported that they were caught between these views during their student teaching and placed in contradictory positions.

5. Students further reported in interviews that they were unable to isolate any outstanding college experience which had influenced their social and philosophical views. They also reported that their college courses rarely challenged them to deal with social and educational issues and that they rarely pursued independent inquiry along those lines.

There did not appear to be a well-defined professional-education community within the university with which these

students identified and which they felt was respected by the university community.

A program of action research to improve student values was recommended. It included:

a. A study to improve the "reference-value" of the college community in order to produce concern with social issues and bring about examination of educational views.

b. A study to utilize differences in educational views between cooperating teachers, college faculty, and students to bring about greater examination of educational views and, hopefully, more consistent views.

c. A study to determine the effect on student values of the intensive study of the educational problems of a segment of the urban community.

d. A study to explore ways of bringing students to greater awareness of their knowledge and beliefs to determine the effect on values of this awareness over a period of time.

e. A study to improve values through increasing informal faculty-student contact and emphasizing a vital contemporary theme during these informal sessions.

Microfilm $3.25; Xerox $11.25. 250 pages.

A SURVEY OF THE PROFESSIONAL PRACTICUM COURSE OF THE STATE COLLEGES OF THE COMMONWEALTH OF PENNSYLVANIA

(Order No. Mic 61-1877)

James Dean Lawson, Ed.D.
University of Pittsburgh, 1961

It was the purpose of this research to identify and study the content and practices of the Professional Practicum, a two credit course directly associated with the student teaching experience, through an evaluation of the responses of selected teachers and instructors who had participated in it. A primary objective was to establish findings which could be of value to state college officials in re-assessing and/or improving the practicum course.

The survey instrument was prepared following an extensive review of the professional literature on group conferences and seminar experiences associated with the student teaching experience and subsequent to interviews of state college officials directly responsible for the student teaching program.

Usable returns were received from 52.4 per cent of the 2409 teachers queried and 61.0 per cent of the practicum instructors. The teacher respondents represented those state college graduates of 1958 who had taught in the public schools during the 1958-59 term. The practicum instructors queried were those who had taught the course during 1958.

The survey instrument, was designed so that a measure of additional choice could be indicated both about what had been experienced in the practicum course and about what should be included. In addition to Part V of the survey instrument seeking free responses the following subdivisions followed the section on instructions:

Part I - Personal Data
Part II - General Experiences of the Professional Practicum
Part III - Specific Experiences of the Professional Practicum
Part IV - Organization and Administration of the Professional Practicum.

In Parts II, III, and IV, information was sought relative to: (1) general objectives of the course; (2) specific content; (3) the most desirable practices for organization and administration.

Specific experiences were evaluated within the areas of (1) student teaching orientation; (2) specific student teaching problems; (3) knowledge of Pennsylvania School Law; (4) job placement; (5) knowledge of the educational profession; (6) knowledge of the community.

Practices in organization and administration sought to answer questions concerning practicum (1) location; (2) frequency; (3) timing; (4) instructors; (5) membership.

The responses of the teachers were weighted, placed in rank order and contrasts were drawn between what was experienced and what was recommended by them. These opinions were further contrasted with the opinions of the practicum instructors and the tabulations resulting from free responses of both groups.

The findings and conclusions indicated that (1) there was close agreement between teacher and practicum instructors on what was experienced and what was recommended; (2) all experiences listed under general and specific content were recommended for inclusion as either fairly desirable or extremely valuable; (3) content was more strongly desired than it had been experienced; (4) practices in organization and administration indicated a combined respondent opinion favoring:

a. Membership for all student teachers of the semester who are in the same area of certification;

b. A location at the place of student teaching assignment when the numbers justified a satisfactory seminar;

c. Instruction by college supervisors;

d. Weekly timing;

e. Provision of time from the regular student teaching assignment.

It was recommended that:

1. An organized effort should be made by the state colleges of the Commonwealth of Pennsylvania to cooperatively develop a Professional Practicum Course Program which also meets the needs of the respective colleges.

2. School administrators in planning orientation programs and in-service training for first-year teachers should give further consideration to first-year teacher needs. Microfilm $3.10; Xerox $10.80. 240 pages.

ABILITY GROUPING AND TEACHER ATTITUDES: AN EXPLORATORY STUDY OF JUNIOR HIGH SCHOOL TEACHERS AND THEIR COMMITMENT TO ABILITY GROUPING.

(Order No. Mic 61-2710)

James Archibald Phillips, Jr., Ed.D.
Michigan State University, 1961

Major Professor: Charles A. Blackman

The investigation is an exploratory study to determine whether teachers highly committed to ability grouping reflect different attitude patterns toward pupil-teacher relationships, as opposed to those less committed to ability grouping; and to explore possible relationships between teachers' personal and professional backgrounds and their commitment to ability grouping.

The sample consisted of all junior high school teachers in twelve schools in five county systems in Maryland. A total of 440 teachers was involved.

An index of commitment to ability grouping was developed. Validity of items was determined by scalogram analysis, coefficient of reproducibility, 85 per cent. The Minnesota Teacher Attitude Inventory (MTAI) served as the index of teacher-pupil rapport. The total instrument administered by the investigator consisted of eleven questionnaire items about teachers' personal and professional backgrounds, seven items related to beliefs about ability grouping, and the MTAI. An F test was applied to mean score differences for each of the indices for each of the factors investigated. The .05 level of significance was established for statistical computations. A least significant difference test was employed to determine subcategories for the factors which contributed the significant differences. Principals in the participating schools were interviewed to gather information about staffs, programs, and policy determinants.

The following relationships of factors to the two indices are reported: Significant index of commitment mean score differences only were found for age of respondents, North-Hatt Index of Occupational Prestige (father's occupation), amount of college education of respondents, grade level taught by respondents, and respondents' experience with grouping practices.

Significant mean score differences for both indices were found for respondents' amount of college education, major field of study at the undergraduate level, type institution in which respondents matriculated at the undergraduate level, degree held by respondents, subject area taught by respondents, and respondents' stated preference for type ability group to teach.

Insignificant F values were found for respondents' sex, marital status, size and type community in which respondents were reared, attained educational level of respondents' parents, amount of graduate study completed by respondents, and respondents' years of experience. Significant mean score differences were not found for schools and school systems.

Coefficient of correlation of relationship between commitment to ability grouping and MTAI scores =.0065. Though too small to be significant, limited evidence of patterns of inverse relationships between index of commitment mean scores and MTAI mean scores was found.

Limited evidence of a relationship between school staff involvement in policy making and the two indices was found - the greater the involvement of staff the lower the index of commitment and the higher the MTAI scores.

Among the conclusions resulting from the study are the following:

1. Teachers' commitment to ability grouping can be ascertained.
2. There may be some inverse relationship between a teacher's commitment to ability grouping and his ability to create good rapport with pupils.
3. There appear to be factors in teachers' personal and professional backgrounds related to commitment to ability grouping.
4. Most teachers indicate a preference for ability grouping and prefer to teach groups with average or above ability.
5. A need for further research into grouping practices and results in which the teacher factor is controlled is indicated. Microfilm $3.50; Xerox $12.15. 270 pages.

PROPOSALS FOR IMPROVEMENT OF SCIENCE TEACHING IN NEW JERSEY ELEMENTARY SCHOOLS

(Order No. Mic 61-3)

Evan Carleton Richardson, Ed.D.
Rutgers University, 1960

The over-all purpose of the study was to develop proposals for the improvement of science teaching in New Jersey elementary schools. In pursuing this purpose the following actions were taken: (1) identification of science activities and programs which are in accord with the objectives of elementary education and consistent with our present understanding of the developmental differences of children; (2) identification of the present condition of science teaching in New Jersey elementary schools; and (3) identification of factors which seem to be related to effective science teaching practices and programs. Data were collected to test hypotheses that quality of science teaching is related to (1) extent of teacher preparation in science, (2) mean intelligence quotient of class groups, (3) class size, (4) yearly cost per pupil, (5) type of community and (6) type of supervisory personnel.

A checklist, validated by two juries of experts, was used for appraisal of 54 typical science lessons from kindergarten through grade eight in 22 selected schools. Quality indices--which quantified the value judgments about each observed lesson or the science teaching methods, facilities and materials used--were taken as the ratio of the observer's ratings to the averaged jury ratings for the checklist items. A principal's questionnaire and an inventory for one teacher from each major level, K-3, 4-6, and 7-8, supplied the background information from the selected, and also from 77 additional unselected elementary schools.

I. FINDINGS

The general quality of science teaching for all lessons at each major level was indicated by the quality indices of 0.47, 0.42, and 0.37 for the K-3, 4-6 and 7-8 levels

respectively. Limited use was found for activities to develop the abilities and interests of children, as indicated by the quality index of 0.39 for the pertinent checklist items. Similarly, limited use was found for activities relating to the objectives of developing understanding, scientific attitudes and problem-solving aptitudes for which quality indices of 0.46, 0.46 and 0.33 respectively were found. The fact that the most frequently used learning tool for science was the science demonstration stood in sharp contrast to the fact that the least used learning tool was the science experiment.

Physical science topics were used less than nature study topics and from K-6 the unbalance was very noticeable. Similarly, teachers and principals (93% of the latter had begun as teachers) were poorly prepared in science: (1) fewer than 40% had taken more than one introductory physical science course; (2) usually, the science courses had included few or no laboratory experiences; and (3) the science courses taken had not provided for the development of the problem-solving facets of scientific investigations.

The average amount of time used for science teaching by all the respondents was 111 minutes, or 7.4% of a 1500-minute week. In the upper grades, the amount of time varied from 250 minutes to 30 minutes per week.

Many principals did not require time for science teaching, and others restricted the learning situation in science in various ways. For example, they restricted the use of field trips or resource persons outside of the school; they forbade the use of experiences such as those requiring the use of open-flame or hot-plate heat sources, of acids or alkalis for certain chemical reactions, or of experiences that were likely to produce unpleasant smells (as in the making of cheese or in fermentation); and many made no effort to obtain needed reading and scientific resource facilities and materials.

Elementary-school science consultants generally seemed to stimulate the science programs, yet the three districts in which classes supervised by consultants were observed showed considerable variance in the objectives and the methods in use. The desirable consultant role seemed to be that which assists, guides and motivates the regular classroom teachers to lead the science teaching facets of the curriculum.

Active in-service programs for science teaching marked several districts 14 of which were using science trained or especially interested teachers as resource helpers. Although the teachers verbalized worthy objectives, many did not seem to realize how far short they were falling. In addition, the findings of research in elementary-school science deny certain preconceived notions that many teachers seemed to have, notions such as: (1) specific science experiences are best suited to a definite grade level; (2) science programs for slow learners are undesirable teaching assignments; and (3) children develop science concepts satisfactorily from verbalized experiences.

The quality of science teaching was found to have a +0.49 correlation relationship, at the five percent confidence level, with the extent of teacher preparation in science courses.

Science lesson quality was found to have a +0.51 correlation, also at the five percent level, with the mean intelligence quotient of those classes for which the information was available. However, this finding is held as questionable because slow learner children appear to be at a disadvantage in situations that depend in part on reading, writing and discussion abilities. In addition, the number of cases was poorly distributed in the several categories.

The data found for testing the hypotheses that science teaching quality depends on class size, yearly cost per pupil, type of community and type of supervisory personnel led to no conclusive results.

II. PROPOSALS

1. Each teacher, principal and supervisor should satisfactorily complete introductory laboratory-type courses in Biology, Chemistry, Physics and Earth Science and a course in Methods of Elementary-School Science.

Graduation requirements of higher education institutions preparing elementary school teachers should include these courses and provide the laboratory facilities to permit individual student responsibility for the laboratory experiences. High school science courses similarly should have adequate facilities.

2. Introductory science courses offered in colleges and high schools should be designed to assure that lecture and laboratory work include conspicuous experiences for the problem-solving facets of each course.

3. The teaching of science in the elementary school should be a major responsibility in the K-6 grades. It should be centered around problem-solving situations with sufficient permissiveness and freedom to develop individual differences. Not only should it be planned to discover and nurture science talents early in the school years, it should be adjusted also to meet the needs of slow learners.

4. In the upper grades the amount of time for science teaching may well be lessened but it should be taught by science majors who would continue the problem-solving emphasis of the earlier years.

5. Frequent use of resource persons and places should be encouraged. Teachers should have the freedom to determine what science activities are appropriate rather than being bound by dicta that prohibit certain kinds of experiences.

6. Each classroom should have facilities suitable for simple laboratory experiences. Teachers should have the responsibility of determining the requisite printed and science material resources. Each teacher should have a budget item also to care for the unexpected petty cash needs of the program.

7. Teachers with rich science backgrounds should be used as resource persons to help other teachers and supervisors with the science teaching problems.

8. The administration should emphasize science by a variety of school-wide activities.

III. RESEARCH

1. An attempt should be made to determine why many teachers, principals and supervisors appear to be satisfied with a learning environment that emphasized verbalized subject matter, that appears to deny the more pervasive goals and that shows little or no recognition of the principle of individual differences.

2. Research should attempt to identify the values that come from science experiences that are introduced long before children can verbalize the concepts involved.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

3. Research should examine the relationship that may exist between the quality of science teaching and the science training and background of the teacher.

4. Research should be undertaken in many schools to determine the kinds of objectives and activities which are appropriate for slow learners and also to determine if teachers generally prefer to avoid the responsibility for teaching science to the slow learners.

5. Research should be done to identify the kinds of activities which are likely to influence the development in children of scientific attitudes, problem-solving aptitudes and their individualistic interests and talents.

Microfilm $2.75; Xerox $7.60. 164 pages.

A TEAM APPROACH TO THEORY AND PRACTICE IN EARLY CHILDHOOD TEACHER EDUCATION

(Order No. Mic 61-2339)

Mildred Rochelle Sabath, Ed.D.
Wayne State University, 1960

Adviser: Ole Sand

Area of Investigation:

This research project had three major purposes: (1) to integrate theory and practice in teacher education, (2) to assess the values of peer group interaction in promoting a sense of identity with a group; and (3) to evaluate students' reactions to a partnership assignment in initial student teaching. Two sub-purposes were: (1) to evaluate students' perceptions regarding the values of the psychological support manifest in a group situation, and (2) to focus on the content in the field of early childhood education.

The Methodology Employed:

A team approach to teaching-learning was developed on three operational levels: (1) conducting a seminar class by two college faculty members, (2) assigning two students who functioned as partners in a single student teaching assignment, and (3) integrating the seminar and student teaching.

Procedures used to select the twenty students included expressed preference for early childhood education, a 2.25 honor point average, and/or a ranking on or above the fortieth percentile on the American Council on Education aptitude examination.

Students in their partnership assignments each taught half the semester in kindergarten and half in a primary grade. They met on the campus for three hours a week in a course designed as a problems seminar which was conducted by the two faculty members who also supervised these students in student teaching. The theory sessions dealt with principles of educational theory and were closely coordinated with the field situation.

College records and personal data sheets were consulted to obtain information about the students. Additional data about the students' needs and progress were gathered through the use of a variety of instruments including the Juul T Scale,[1] the Kerlinger Education Scale II,[2] and the Hemphill Group Dimensions Questionnaire.[3] The written documents of students and supervising teachers, and observations and interviews were other sources of data. A widely used reference book in early childhood education and identified professional competencies as recorded in professional literature were employed to assess educational gaps.

Findings:

The findings concerning the purposes of the study were: (1) The organization and sequence of events contributed to the professional growth and learning of students. This project provided qualitative opportunities for most students to integrate theory and practice through individualizing their own learning. (2) Students developed a feeling of confidence in themselves as a result of closeness in relationship to peers and the faculty team. They utilized many opportunities to test their developing professional skills. (3) The partnership assignment was satisfying and contributed to productive educational ends. (4) Anxiety and a sense of isolation were reduced as experiences were shared with a group. (5) Familiarity with the content in early childhood education and an increase in knowlege were evidenced in students' behavior.

The major weaknesses or limitations perceived by the participants were centered primarily around the process of the seminar sessions. Some individuals were unable to adequately assert themselves in an unstructured situation. Another weakness resulted from the half semester assignments to kindergarten and the primary grades. Despite the few dissatisfactions, the general consensus was that the values achieved far outweighed the limitations.

Research Needed:

Major studies to be designed as an outgrowth of this dissertation included: (1) a study of team teaching with large numbers of students, (2) study of curriculum designs related to student personalities, and (3) investigation into the dynamic factors affecting partner relationships in student teaching.

1. Kristen Juul, "Authoritarian Personality in Relation to Teachers' Attitudes Toward Child Behavior," (Unpublished Ph.D. dissertation, College of Education, Wayne State University, 1954).

2. Fred N. Kerlinger and Esin Kaya, "The Construction and Factor Analytic Validation of Scales to Measure Attitudes Toward Education," Educational and Psychological Measurement. (Spring, 1959), 13-31.

3. John K. Hemphill, Group Dimensions, A Manual For Their Measurement. Research Monograph Number 87, The Ohio State University Bureau of Business Research, 1956.

Microfilm $4.30; Xerox $15.10. 335 pages.

THE DEVELOPMENT OF A SCALE FOR MOTIVE ASSESSMENT: ACHIEVEMENT AND AFFILIATION.

(Order No. Mic 61-1353)

Bill Ray VanZandt, Ed.D.
University of Arkansas, 1961

Major Professor: Dr. John Schmid

Introduction

The effects of the motive characteristics of teachers have not been given adequate consideration. Two motives seem logically involved in the teacher-pupil relationship afforded by the classroom situation. The achievement motive is defined as a goal oriented desire to become involved in and successful with tasks which are perceived by the individual as success characteristics. The affiliation motive is defined as a desire to establish, maintain, restore or enhance positive personal relationships based on the inherent value of the human personality.

The intent of this study was to develop a structured scale for the assessment of these motives. Many of the scales which have been developed and have possessed desirable characteristics for motive assessment have been limited in their utility due to complex scoring systems.

It was postulated early in the investigation that assessment would have to be based on items which were specific to the teacher's environment and sufficiently general to allow considerable latitude in applicability. It was also felt that motive stability is directly related to the stability of the situation through which assessment is made. These two things seemed to point to a type of item which would involve projective traits and would be based on situations familiar to the individual or group being assessed. In this case, the concern was with a teacher population of specified limits of experience and teaching areas.

Procedure

The original items, consisting of a stem which described a public school problem or situation in terms of the two motive references and a neutral response, were administered to 130 teachers with varied biographical traits in the public secondary schools of the State of Missouri. Item-total score correlations were computed for the 180 original responses. The 90 responses having the greater item-total correlation were selected for inclusion in the final scale of 30 items. Various scoring schemes were investigated in an attempt to find the scoring method which would allow the greater independence of the motive scores. The resulting scoring scheme directed the teacher to select two of the three responses, one which he considered to be the most desirable and one which he considered to be the least desirable. The most responses were given a value of two and the least responses were given a value of zero. The responses not marked were given a value of one.

Test-retest reliability was based on 120 teachers in the public secondary schools of the State of Arkansas with approximately a five week interval. These teachers represented the following instructional areas: English, mathematics, science and social studies. Their teaching experience ranged from one to ten years. Biographical data and other test scores were secured for subsequent study.

Results

The answers to given questions guided this investigation.

1. Can a scale, having test-retest reliability, be developed for the assessment of achievement and affiliation motives through use of a forced-choice method?

The test-retest reliability estimate was .59 for the achievement motive, .44 for the affiliation motive and .68 for the neutral score (N=120). All coefficients were significant at the .001 level.

2. Does the experienced teacher produce more intense manifestations of the achievement motive or the affiliation motive?

The mean score for the achievement motive was found to be significantly higher than the affiliation motive. The variance of the affiliation scores was significantly smaller than the achievement scores.

3. Is there a significant relationship between affiliation and achievement motive scores and teacher mobility as indicated by the distance of present residence from place of high school graduation?

The coefficients of correlation between these three variables were not significant.

4. Is there a significant relationship between affiliation and achievement motive scores and the size of secondary school in which the teacher is employed?

This question was answered negatively.

5. Are achievement and affiliation motive scores significantly related to salary when length of experience is partialled out?

This question was also answered negatively.

Scores from the motive scale and scores from three other trait measures were compared. Motive scores were not significantly related to scores from a measure of knowledge of educational psychology and scores from the George Washington Series, Social Intelligence Test; however, significant and encouraging relationships were found between the motive scores and part scores from a teacher attitude test. The achievement motive scores correlated .54 ($P < .001$, N=120) with a measure of the teacher's positive attitude toward professional activities. The affiliation scores correlated .37 ($P < .001$, N=120) with a measure of the teacher's tendency to be concerned with social skills over academic skills.

Recommendations were made for further study concerning this scale which would emphasize greater refinement involving more controlled administration, influence of experimental arousal, relationship of scores to other motive measure, development of definable validity criteria, differences in various teacher samples and sex differences.

Microfilm $2.75; Xerox $4.60. 86 pages.

A CRITICAL ANALYSIS OF SELECTED RESEARCH ON STUDENT TEACHING IN UNDERGRADUATE TEACHER TRAINING INSTITUTIONS IN THE UNITED STATES, 1929-1959.

(Order No. Mic 61-2729)

William M. Young, Ed.D.
Temple University, 1961

The purpose of this study was to develop a set of guiding principles, based upon significant findings from research relative to student teaching practices in undergraduate teacher training institutions in the United States, which could be used in planning and evaluating student teaching programs.

The method employed in this study was that of library research. An attempt was made to examine in a critical manner all the research that has been done on student teaching.

As a result of this study of the literature on student teaching, various guiding principles emerged. These principles may be summarized as follows:

1. Teacher training institutions should follow a very flexible course of action in admitting students to their student teaching program.

   It appears from the research that success in student teaching is very difficult to predict. The factors which make for successful teaching are evidently not determinable by any testing program now in use. If a rough prediction of success in student teaching is desired, then the student's (grade average), especially in professional courses, should be examined. But even the grade average yields only a very moderate correlation with success in student teaching.

2. Individual differences should be taken into account in student teaching programs.

   Individual differences should be provided for by varying the length of the student teaching experience depending on the aptitude of the student teacher. The kind of teaching situation to which the student is assigned should also be adapted to the needs of the student.

3. Instructional programs should emphasize four areas to meet the needs of student teachers: (a) handling problems of pupil control and discipline; (b) motivating pupils; (c) planning lessons; and (d) providing for individual differences.

   In any problem inventory of student teaching problems, the above areas inevitably play a prominent part. It would appear therefore that the instruction which is designed to support the student teacher should include a full and meaningful presentation of these problems.

4. Student teachers should have an opportunity to engage in all the activities associated with the role of the classroom teacher.

   In line with this principle are the following recommendations which appear in most of the relevant surveys:

   (a) Student teachers should have the opportunity to plan and teach a lesson with no other adult present.

   (b) Student teachers should not be assigned to activities of a routine nature in which the student teacher plays a relatively passive part unless such activities constitute an integral part of the cooperating teacher's responsibilities.

5. Cooperating teachers should receive special training for their role as cooperating teachers.

   In addition to initial training, there should be a continuous in-service program designed to help cooperating teachers function more effectively with their student teachers. A schedule of regular conferences should be set up between the student teacher and the cooperating teacher. It is also desirable that college supervisors meet with both the cooperating teacher and the student teacher on a regular basis.

6. Evaluation of student teachers should be in terms of written descriptive statements rather than in terms of rating scales which are currently employed.

   It has been a consistent finding that the use of rating scales by themselves does not give a satisfactory evaluation.

Conclusion

It appears that for the most part the research that has been done in the area of student teaching has dealt with small, isolated segments of the student teaching experience. Many important questions have received little attention. In every area of the student teaching experience, there is need for further research.

Microfilm $2.75; Xerox $5.80. 120 pages.

EDUCATION, THEORY AND PRACTICE

THE EFFECT OF CERTAIN TEACHING METHODS ON COLLEGE STUDENTS' ART ATTITUDES AND APPRECIATIONS

(Order No. Mic 61-2348)

Eleanor Audrey Annis, Ed.D.
The Pennsylvania State University, 1961

The observed need for developing a method of more effectively meeting the General Education requirements of art appreciation for freshmen students at Mankato State College resulted in a study of methods of teaching.

The major hypothesis was that selected methods of teaching the course, art appreciation, to college students affect or result in greater change in their art attitudes and appreciations than do the usual methods of instruction.

Subordinate hypotheses were: the experiences involving students in an active manner promote greater change

in art appreciation than do passive ones; the appreciation and attitudes promoted by each of the teaching methods are affected by teacher differences; and the spontaneous-deliberate qualities of the students are influenced by the teaching methods employed.

Pre- and post-tests were administered to General Lecture sections of 100 students. The slide-lecture method constituted twenty-four of the class meetings, and evenly dispersed among them were twelve meetings of special activities. One-fourth of the General Lecture group was placed in each of these activity groups: Lecture, slide-lectures continued by the teacher; Discussion, topics selected and discussion conducted by the students; Materials, student experimentation with various art media; and Discussion-Materials, alternation of six discussion meetings with six materials meetings. Two other groups tested were the Usual Method, a class of about sixty students who had slide-lectures for all of their thirty-six class meetings, and Art Structure, a group whose objective was to experiment and work with various art media. Two teachers cooperated in the teaching, and each teacher had at least one section of each method.

The tests selected to be used were the Beittel Art Acceptance Test, the Kieselbach Aesthetic Perception Test, a Cut Paper Performance Test, and an Art Concept Composition based on the selection of a preferred painting. The gains were analyzed for the subgroups alone, compared with the usual lecture group, and separated into either the spontaneous or deliberate group.

The conclusions were: that some of the methods (Discussion, Materials, and Discussion-Materials) made greater gains than the lecture methods; that greater gains were made by the students who were more actively involved in the class; that one teacher effected greater gain in the activity methods and the other in the more directive methods; and that significant differences in gains may be attributed to spontaneous-deliberate qualities of the students.

The recommendations were in two categories: (1) For teaching: that lecture and non-directive opportunities be coordinated to effect greater gain for all students and that all have an opportunity to work with art media. (2) For further research: that a similar study be made in which the methods are more differentiated by using a smaller number of or eliminating the general lectures; that art appreciation in the General Education program be re-evaluated to establish objectives in terms of students' needs; that the retention or long-range effect of the methods be investigated to determine if one method influences carry-over into activities beyond the classroom more than another; that a study be undertaken to determine whether differences in spontaneous-deliberate tendencies observed actually constitute an art appreciation factor; that a study of methods in relation to the number of students enrolled be conducted to determine the class size where maximum learning may be achieved; and that the question of the importance of any of the teaching methods compared with activity and experience on the part of the student might be studied. Such research would make valuable contributions to the improvement of teaching art appreciation in the general education program.

Microfilm $2.75; Xerox $7.20. 151 pages.

FACTORS AND INFLUENCES IN THE ELECTION OF LATIN BY HIGH SCHOOL PUPILS

(Order No. Mic 61-1860)

Amelia B. Bingham, Ph.D.
University of Pittsburgh, 1961

There exists a premonitory trend in the secondary schools to exclude Latin because of dwindling enrollments and the lack of recruits for teaching Latin. The purpose of this study was to ascertain the factors and influences that determine pupils' election or non-election of Latin at the present time.

The secondary schools which were chosen for the study offered a four-year program in Latin. Four instruments were designed and administered for obtaining the data: Form A, completed by selected high school counselors; Form B, answered by high school homeroom teachers; Form C, filled out by pupils who had elected Latin and who were currently enrolled in Latin classes, ranging from the first year through the fourth year of study; Form D, a free-response inquiry to which graduating seniors replied stating the reasons for their election or non-election of Latin at any time of their high school careers. Of the numbers included in the survey the percentages replying were as follows: counselors, 100; homeroom teachers, 86; Latin pupils, 94.3; graduating seniors, 98.

The findings of the study revealed that the services of guidance on the part of high school counselors and homeroom teachers varied with teaching experiences and exposure to Latin or other foreign languages in their own preparatory backgrounds. There was a tendency to value the objective measures such as prognostic tests, English marks, or honor standing in the recommendation of Latin study. Latin pupils claimed that their decision to study Latin primarily resulted from their own choice. They avowed little influence from counselors and homeroom teachers, but acknowledged parental preference as a second factor. All the respondents agreed upon the highest ranking values of Latin study, namely, aid to the study of language structure and increase of English vocabulary. Graduating seniors who had elected Latin contributed free responses of discernible analytical value, and their unedited testimonials illuminate that section of the study. Those seniors who had not elected Latin gave evidence of advisement against taking Latin on the part of counselors and homeroom teachers, stated no need for it in their chosen work, and characterized it as a difficult subject.

It was concluded from these findings that there will be a significant portion of high school pupils who will elect Latin for preparation in certain professional fields (medicine, teaching, engineering, law, nursing, and science) despite many opposing factors. These include the entrance of competition from modern foreign languages as electives in the first year of high school, advisement from some counselors and teachers whose backgrounds reveal weaknesses in good guidance practices for language study, and current educational theories scoffing at ancient language study for modern curricula.

Recommendations include early introduction of Latin preferably at the seventh and eighth grade levels; employment of prognostic tests as predictive screening devices to reduce casualties; contacts by Latin personnel with the parents, teachers, and pupils through various associations

and opportunities to acquaint these groups with the values of Latin study; changes in pedagogy and methodology to bring new approaches and more meaningful learning materials and activities into classroom practice; requirement of Latin to be prescribed for those pupils anticipating professional fields involving a high level of language skill; researches to explore further the values of Latin study. Those who are responsible for curricular advisement at the secondary level should be more thoroughly schooled in the values of all high school studies, including Latin, if they are going to fulfill their mission in giving objective and informed counsel to our youth.

Microfilm $2.75; Xerox $6.40. 131 pages.

CHARACTERISTIC DIFFERENCES OF TRADE SCHOOL STUDENTS AND THEIR BEARING ON POST-SCHOOL OCCUPATIONAL PLANS

(Order No. Mic 60-6782)

Billie Wesley Brown, Ed.D.
University of Missouri, 1960

Supervisor: H. H. London

PURPOSE: To isolate and compare characteristics of three groups of day-trade students, those who had chosen and were planning to enter the occupation for which they were being trained, those who had chosen an occupation other than the one for which they were being trained and who indicated no intention of working in the occupation for which the training was provided, and those who had made no occupational choice.

METHOD OF RESEARCH: Data concerning 378 day-trade seniors were obtained from an information form, the Strong Vocational Interest Inventory, Ohio Psychological Examination, and grade point average, when the writer visited 37 schools in Missouri. Principals, counselors, and day-trade instructors of these seniors were interviewed to obtain selection factors used in enrolling these students.

SUMMARY: Of the 378 seniors participating in the study, 125 indicated that they intended to enter the occupation for which they were being trained, 126 intended to enter an occupation other than the one for which they were being trained and 127 had made no occupational choice.

A large majority of the participating seniors ranked in the lower one-half of their graduating class on grade point average. Those in the lower quartile were not likely to plan to enter the occupation for which they were being trained.

The most important factor, other than advice of individuals, influencing seniors to enroll in the day-trade program, was experience in industrial arts in junior or senior high.

Seniors who had not made an occupational choice were less likely to have had a conference with their counselor than those who intended to enter the occupation for which they were being trained.

Seniors enrolled in auto mechanics were likely to plan to enter an occupation other than auto mechanics, or to not have made any occupational plan; seniors in machine shop were likely to plan to enter the machinist's trade.

Seniors who intended to enter the occupation for which they were being trained were more likely to believe that a need for skilled workers existed in their respective fields than were seniors who planned to enter an occupation other than the one for which they were being trained, or those who had made no occupational choice.

Seniors who did not plan to enter the occupation for which they were being trained, or those who had made no occupational plans, were likely to give extreme judgments concerning the earning power of skilled tradesmen than seniors who planned to enter the occupation for which they were being trained.

CONCLUSIONS: Seniors who plan to enter the occupation for which they are being trained are likely to be enrolled in large, urban area day-trade programs.

Seniors who intend to enter the occupation for which they receive training are likely to be influenced to enroll in the program by their fathers; those who have made no occupational plans are likely to be influenced to enroll in the program by their classmates.

Seniors who intend to enter the occupation for which they are being trained are likely to have fathers employed in skilled occupations.

Principals and trade teachers tend to believe that seniors who intend to enter an occupation other than the one for which they are being trained, or who have made no occupational plans, are enrolled in the day-trade program for exploratory purposes. Counselors believe these seniors are enrolled to fix their automobile, they cannot succeed academically, or the program is exploratory in nature.

Principals, counselors, and day-trade instructors seem to be unaware of local, state or national labor market needs, or the importance of this in enrolling students in the day-trade program.

Microfilm $2.75; Xerox $9.70. 211 pages.

THE EFFECT OF REINFORCEMENT IN TEACHING ARITHMETIC ON THE PERFORMANCE OF FIFTH GRADE STUDENTS

(Order No. Mic 61-2365)

Betty Davis, Ed.D.
The Pennsylvania State University, 1961

Statement of the Problem. This study attempted to investigate the effects of different schedules of reinforcement upon the learning of arithmetic in fifth grade classrooms.

The Procedure. An experiment was conducted using three groups of fifth grade pupils, each group working at separate times under two different schedules of reinforcement and one schedule of non-reinforcement to determine the following:

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

1. The proportional accuracy of arithmetic skills under two types of reinforcement as well as under non-reinforcement.
2. The retention of subject matter taught under two types of reinforcement as well as subject matter taught when no reinforcement was used.

The study extended over a nine-week period and was limited to three classes in arithmetic on the fifth grade level. Each group used in the experiment followed a specific schedule of reinforcement for each three-week interval. At the end of every three-week period a test was administered to each group.

Three months after the completion of the experiment, parts of these unit tests were re-administered to each group to test the retention of the arithmetic material learned under each schedule as well as the retention of the total arithmetic material learned during the nine weeks of the experiment.

Major Findings.

1. The average daily performance of groups A and B was noticeably affected by the non-reinforcement (NR) schedule.
2. Groups A and B showed a loss in the proportional accuracy under all three working schedules: fixed-ratio (FR), fixed-interval (FI), and non-reinforcement (NR).
3. Group C showed a gain in the proportional accuracy under two schedules (FI, NR) and a slight loss, not significant, under one schedule (FR).
4. The individuals in groups A and C maintained their relative performance throughout the entire experiment; the relative positions of the individuals in group B shifted greatly during the entire experiment.
5. A comparison of the results of the retention tests with the same material selected from the unit tests showed a significant loss in the accuracy at the 5 per cent level for both groups A and B with the exception of the first three weeks of the experiment.

Conclusions. The results of the experiment indicate that the learning behavior pattern acquired during a period of non-reinforcement (NR) extends over a longer period of time than the learning behavior acquired during a similar period of reinforcement. They indicate also, that the behavior acquired under a long period of reinforcement is not noticeably affected by non-reinforcement when it is administered for a short period of time.

Arithmetic material learned under a fixed-ratio (FR) schedule of reinforcement is retained longer than arithmetic material learned under either the fixed-interval (FI) schedule or under a schedule when no reinforcement (NR) is given.

The results of the test of retention of arithmetic previously learned support the fact that arithmetic material which is learned under a schedule of reinforcement is retained longer than similar material learned under a schedule of non-reinforcement or a schedule of reinforcement which follows non-reinforcement.

Microfilm $2.75; Xerox $6.20. 130 pages.

AUDIO-VISUAL SECOND-LANGUAGE LEARNING: A HISTORICAL REVIEW AND COMPARATIVE EVALUATION OF THE USE OF AUDIO-VISUAL INSTRUCTIONAL MATERIALS AND TEACHING TECHNIQUES IN FIRST-YEAR HIGH SCHOOL FRENCH.

(Order No. Mic 61-2328)

Naida Marich Dostal, Ed.D.
Wayne State University, 1960

Adviser: Joseph E. Hill

Problem: This study concerned itself with the specific problem of ascertaining whether high school pupils in a first-year program of French conducted with experimental, audio-visual instructional materials and teaching techniques acquire a greater facility in understanding and speaking the language than do those pupils who work with standard materials and teaching procedures.

Sample: There were 282 pupils in first semester French classes using experimental, audio-visual materials in the fall semester of 1957 in the Detroit public high schools. This pupil population was equated numerically by selecting 283 pupils in four other high schools to form a control group.

Differences in the pupil and teacher populations: The experimental group had a one per cent advantage in age, grade and socio-economic levels. Chi square was used to calculate the significance of the difference in numbers. A greater number of older pupils brought more maturity, skills and knowledges to the learning situation than did the younger pupils. A greater number of pupils in the experimental group had parents in the professional-managerial category of occupations. Social classes affect school achievement; the higher the class, the higher the achievement. The experimental group also had the advantage of listening experiences in the language laboratory beyond the regular class period on a voluntary basis. However, the experimental group had the disadvantage of having more pupils in the low (D, E) category of the intelligence quotient scale than the control group. This difference in numbers was significant at the one per cent level.

There were no significant differences among the teachers other than the presence of one native French teacher in the experimental group and one French teacher with a Ph.D. in modern languages in the control group.

Testing Instruments: The author designed two audio-visual French tests to measure the abilities to understand, speak, read and write at the end of the first and second semesters of study in high school. The Cooperative French Test, Elementary Form R, was also administered in the absence of a more adequate, standardized test. This test measures silent reading, isolated vocabulary items and grammar out of context.

Findings: Medians were calculated from the frequency distributions of all the test scores. The "t" test was used to calculate the significance of the difference between medians of the experimental and control groups.

On the basis of the scores obtained from the Cooperative French Test, the control group was superior in reading, vocabulary and grammar at a very high level of significance.

On the basis of the scores obtained from the first semester audio-visual French test, the experimental group had a significant one per cent advantage in the abilities to understand and speak; the control group had a significant five per cent advantage in reading. However, the scores of the reading test piled up at the high end of the scale, indicating that the test was too easy. The second semester audio-visual French test revealed a significant one per cent advantage in speaking for the experimental group.

Interpretation: It is, therefore, evident from the findings that the experimental group conducted with audio-visual instructional materials and teaching techniques did achieve greater facility in the ability to speak at the end of one year of study. However, the experimental group lost its significant one per cent advantage in understanding at the end of the second semester of study.

If such results are obtained from the use of experimental materials and teaching techniques with minimal language laboratory facilities, one can expect even greater results from well-programmed materials, improved teaching techniques and modern electronic installations.

Microfilm $3.20; Xerox $11.25. 246 pages.

READABILITY AS A KEY FOR EVALUATING JUNIOR COLLEGE FRESHMAN ENGLISH ANTHOLOGIES

(Order No. Mic 61-2526)

Marvyl Doyle, Ed.D.
University of Southern California, 1961

Chairman: Professor Calvert

Evaluation of anthologies for the junior college freshman English course is complicated by the disparate purposes for which the textbooks are used, by the wide range of students' reading abilities, and by the large number of anthologies available. To supplement judgments of literary merit and other qualitative appraisals, an objective criterion for selecting anthologies is needed. Readability analysis appeared, potentially, to provide such a criterion.

The purpose of this study was to select and evaluate the most suitable readability formula as a tool for appraising junior college freshman English anthologies. The study had five objectives: (1) to review literature about freshman English anthologies and about readability formulas, (2) to determine which formula was most suitable for measuring the readability of the anthologies, (3) to ascertain the validity of the most suitable formula for predicting difficulty in comprehension encountered by junior college freshmen in their reading, (4) to obtain readability data on a group of anthologies in use in California public junior colleges, and (5) to suggest applications of readability analysis which could result in improved methods of selecting and using anthologies.

The first objective was met by examining literature concerning the anthologies and by tracing the development of readability formulas. The second objective was attained by applying criteria for the most suitable formula to three readability formulas. The Flesch Reading Ease Scale was chosen as the tool for the investigation. To meet the third objective, a readability test was constructed and administered to selected junior college freshman English classes. The test consisted of passages on three topics, each written at three levels of readability and followed by comprehension questions. Test data were statistically treated by analysis of variance. To attain the fourth objective, a survey of anthology use in California public junior colleges was conducted; five anthologies were then analyzed for readability. The fifth objective was reached by drawing conclusions and recommendations from the obtained data.

Findings. Evidence secured from the readability test indicated that mean comprehension scores increased significantly as readability of the test passages was increased. There were no significant differences in comprehension of the three topics. The survey of anthology use revealed at least thirty-five different anthologies were used in California public junior colleges during the 1959-60 academic year, and a number of colleges had either changed anthologies within the past two years or planned to do so. According to the readability analysis, the five anthologies differed considerably in the percentage of easy and difficult selections they contained.

Conclusions. Findings of the study appear to support three conclusions. (1) The Flesch Scale is an appropriate and valid instrument for appraising junior college freshman English anthologies. (2) There is no consensus among junior college English departments regarding satisfactory anthologies. (3) The five textbooks could not be used with equal success in all junior college freshman English classes.

Recommendations. The following curricular applications seem justified. (1) Textbook selection committees should utilize readability data in appraising anthologies. (2) Instructors should consider readability information in distinguishing materials which are appropriate to the several purposes for which the anthology is used.

Certain recommendations to editors and publishers seem warranted. (1) Freshman English anthologies should contain a number of selections at each suitable readability level. (2) Readability data concerning anthologies should be provided with the textbooks. (3) Publishers should prepare and advertise textbooks specifically for the junior college freshman English course.

Future research might profitably be directed to development of techniques for employing electronic data processors in making readability analyses, to college-wide projects for checking textbook readability, to creation of a unified theory of readability, and to establishing methods for measuring the conceptual difficulty of reading material.

Microfilm $3.55; Xerox $12.40. 274 pages.

AN EVALUATION OF THE FIELD TRIP IN THE FORMATION OF SOCIAL CONCEPTS AND GENERALIZATIONS

(Order No. Mic 61-2330)

Edith C. Forster, Ed.D.
Wayne State University, 1960

Adviser: Ruth Ellsworth

Purpose of the Study

It is the thesis of this study that a thorough knowledge of the community can best be acquired through first-hand experience. More specifically, the writer believes that the process of gaining, reinforcing, deepening, and broadening the basic social concepts and generalizations essential to modern living is facilitated by taking children on field trips to see in operation those facts about which they have been reading and talking.

This study is designed to test the following hypotheses, where applicable:

1. There is a significant difference between learning social concepts and generalizations through taking field trips and learning them through classroom study
   a. In total test scores
   b. In an item analysis of test scores
2. Field trips stimulate increased interest in the areas studied
3. There is a significant increase in the retention of social concepts and generalizations learned as a result of taking field trips

Design of the Study

The study design calls for the use of two 4B social studies classes in each of four schools in the Detroit public school system. The schools were selected with the advice and consent of the Social Studies Division and the Department of Instructional Research of the Division of Instruction of the Detroit Public Schools. These schools met three criteria: (1) they were large enough to have two classes of 4B children taught by the same social studies teacher, (2) the teachers were recommended by the Social Studies Division, and (3) the four schools represented a cross section of the Detroit school population as determined by the Department of Instructional Research.

Four chapters in the textbook used in the grade, representing four important areas in the industrial life of an urban community, were selected. These topics for study and the trips taken in connection with them were:

Chapter 3, "How Automobiles Are Made" - Ford Motor Company
Chapter 6, "Feeding Our City" - Atlantic and Pacific Produce Terminal
Chapter 11, "Let's Go Places" - Fort Street Depot
Chapter 12, "Exchanging Ideas" - Detroit News and WWJ-TV

The teacher was asked to teach both classes in exactly the same way. Immediately after both classes had studied the chosen topic in the selected chapter, the pupils took Test B, the pre-test. The following class period the experimental group planned the field trip and on the next day on which the experimental group had a social studies class the field trip was taken. On these two days the control group engaged in a comparable worthwhile class-room activity during the social studies period.

The next class period both groups took Test A, the posttest. When the study of the topic was completed, the pupils filled in an Interest Questionnaire. At the end of the semester a retention test was administered to both classes.

The switch-back technique was used in this design; that is, the experimental group in the study of the first and third topics became the control group in the study of the second and fourth topics, and vice versa.

In analyzing the results of the tests, matched pairs were used. The pupils were matched on the basis of age, sex, intelligence, socio-economic status, school achievement, and scores on the pre-test. The results of the posttest were analyzed using the t-test to determine whether any significant difference was obtained. An analysis of items on both pre- and posttests was also made, using chi-square. The t-test was also used in analyzing the results of the retention test.

Findings of the Study

As a result of the analysis of the test results, the following conclusions were reached:

1. A significantly greater degree of learning took place as a result of field trips to the assembly plant, the produce terminal, and the newspaper plant and television studio than occurred as a result of classroom activities. No significant difference in learning took place as a result of the trip to the railroad depot.
2. In the item analysis of test questions, while comparison figures seem to indicate a superior growth in understanding on the part of the experimental group, on no test item was there any result that is statistically significant and can be clearly substantiated in favor of the field trip.
3. The results of the Interest Questionnaire were inconclusive, and do not indicate greater interest on the part of the experimental group.
4. There was no significant difference between the two groups on the retention test.

Microfilm $4.65; Xerox $16.45. 361 pages.

FAMILY LIFE EDUCATION IN THE PUBLIC HIGH SCHOOLS OF PENNSYLVANIA, 1957-58.

(Order No. Mic 60-4436)

Allan Adale Glatthorn, Ed.D.
Temple University, 1960

This study of family life education in 637 Pennsylvania high schools surveyed the administrative provisions of separate courses in family living, the course content, the teaching techniques, and the teachers' background. The

study also surveyed family life education incorporated into existing courses like health education and home economics (called "integrated courses").

Findings

The principal findings of this study were:

1. Slightly more than half of the 124 separate courses, 51.7 per cent, were elective, rather than required, and two thirds were available only to twelfth grade students.
2. Most of the courses, 75.4 per cent, were offered to both boys and girls; 74.4 per cent of this group did not segregate the sexes for instruction.
3. Seventy of the teachers indicated that they planned to make no changes in the course at all.
4. The broad area of "Marriage" received the most attention (median, 17 periods), and the broad area of "Sex Education" received the least attention (4.8 periods).
5. The specific topic receiving the most attention was "Problems in Marriage," a median of 2.2 periods; the topic receiving the least attention was "Nocturnal Emissions," a median of .1 period.
6. The teachers of family living exhibited certain common characteristics: most (53.1 per cent) were men; median age, 39.9; married, 78.1 per cent; had two children; had two brothers or sisters; had taught family living for a median of 3.8 years; had a bachelor's degree, 52.1 per cent; had taken a median total of three graduate and undergraduate credits in marriage and family living; none belonged to any of the professional organizations usually identified with the field of family life education.
7. More than 90 per cent of the teachers believed that all students should take the course, that the course should be expanded, and that the course had been of great help to most of the students.
8. Among the integrated courses, the health education courses devoted most time to "Sex Education," more time than that given by the separate family living courses. In all other areas the family living courses devoted more time than did any of the integrated courses. The home economics courses devoted most of their time, a median of 9.5 periods, to the broad area of "Dating and Courtship." The social studies courses devoted most of their time, 6.8 periods, to "Psychology and Personality."

Conclusions

Within the limits of this study, the following conclusions seem to be valid:

1. Relatively few public high schools in Pennsylvania offered separate courses in family living, and a small percentage of the school population were reached by those courses.
2. Most such courses are not available to the younger tenth grade students who would seem to need a course of this sort.
3. The family life education courses seemed to be very superficial in coverage of material, sometimes neglecting important topics completely or devoting only a few periods to rather complex subjects.
4. The teachers of these courses would seem by and large to possess the personal traits desirable, but have had inadequate professional preparation and have not joined any related professional organization.
5. The fact that many of the topics included as part of family life education are also covered in other school courses would indicate that there must be much duplication and repetition of material.
6. The integrated courses devoted much less time to family life topics than did the separate courses; consequently, the coverage was even more superficial.

Microfilm $3.70; Xerox $13.05. 286 pages.

EDUCATIONAL SOCIOLOGY — A STATUS STUDY.

(Order No. Mic 61-2533)

Richard Gjermund Hoyme, Ed.D.
University of Southern California, 1961

Chairman: Professor Brackenbury

According to the scholars who have labored in the cause of educational sociology, the field in the past has been poorly delimited and ill defined. By using five hypotheses this study attempted to ascertain whether these conditions still exist. Validation was sought for the following hypotheses: (1) The topics or areas studied in educational sociology are diverse in scope and numerous. There is little, if any, agreement between professors of education and sociology upon the topics or areas of appropriate study, as well as the areas of subject matter actually taught, in educational sociology. (2) The objectives of educational sociology vary with each course and each instructor. (3) There is little agreement as to which department, education or sociology, should offer and administer course work in educational sociology. (4) According to the professors of education and sociology presently teaching in the field, most teachers of educational sociology are inadequately prepared. (5) The contemporary field of educational sociology is ill defined and poorly delimited.

To obtain the opinions of sociologists and professors of education, a questionnaire was constructed and disseminated. It was divided into sections dealing with textbook preferences, subject matter, course objectives, and teacher preparation. The sampling, which consisted of 40 sociologists and 128 professors of education, yielded a return of 67 per cent.

Findings and Conclusions. There was a significant degree of agreement between sociologists and professors of education pertaining to the subject matter actually taught in their classes in educational sociology. There was also significant agreement, but to a lesser degree, upon the topics or areas of study appropriate to the field.

There appeared to be little agreement upon the objectives of the beginning graduate course in educational sociology. The objectives varied with each instructor and with each course. Disagreement upon course objectives existed within each group, sociologists and professors of education, as well as between the groups.

There was little agreement between sociologists and professors of education as to the position of the course within the curriculum. Likewise, no consensus existed between the two groups as to which department, education or sociology, should offer the course and by whom,

professors of education or sociology, the course should be taught.

There was very little consensus regarding textbooks. Some forty-nine different textbooks were currently in use in the courses sampled. There was, likewise, little agreement upon any textbook being a "classic" in the field. Many of the instructors indicated a dissatisfaction with the current as well as the past textbooks in the field.

A great breadth of preparation was found to exist among those teaching the graduate courses in educational sociology. The areas of academic preparation and experience were diverse, to say the least. However, when the recipient was asked to indicate an ideal preparation, the preparation differed from that presently existing, and a moderate degree of consensus was discerned. The consensus of the responses indicated the following preparation as the most appropriate for one who is to teach in the field: (1) the undergraduate degree in the social sciences, (2) the master's degree in sociology, and (3) the doctorate in either sociology or educational sociology.

Although the field has been making strides toward a more coherent framework of objectives, obtainable through the study of appropriate subject matter, there was still considerable evidence to support the hypothesis that the field is still ill defined and poorly delimited.

Recommendations. Professors of education and professors of sociology need to become aware of the agreement that does exist among them and devote their efforts to enlarging this consensus in the interest of better defining and delimiting the field of educational sociology.

Microfilm $2.75; Xerox $7.80. 169 pages.

GEOLOGY FOR FLORIDA JUNIOR COLLEGES

(Order No. Mic 61-2235)

Marvin Lee Ivey, Ed.D.
The University of Florida, 1961

While most persons are interested in their environment, little opportunity is provided in the public schools for the study of the earth sciences. Geology is not only an environmental study but also a means of seeking answers about the earth's origin and history. Students should have an opportunity to explore this subject in their general education program.

This study offers a method of systematically organizing or improving a general education science course.

After review of the bases of general education, junior college, and higher education, criteria were developed to judge the worth of course content. These criteria fall into four categories and may be summarized as follows:

I. Criteria Concerning Understanding the Subject
   - A. Criterion one. The course must provide basic concepts about the subject.
   - B. Criterion two. The course must provide information regarding the local natural environment.
   - C. Criterion three. The student should use a method of science to explore some of the topics.
   - D. Criterion four. The material should be of intrinsic interest to as many students as possible.
   - E. Criterion five. The development of each topic should be based upon the student's knowledge. There should be a logical development of the subject.
   - F. Criterion six. The practical values of the field of study to society should be made clear.

II. Criteria Concerning Methods of Teaching
   - A. Criterion seven. The instructor must provide for the wide variety of students in his class.
   - B. Criterion eight. The student's learnings must be evaluated often.
   - C. Criterion nine. The instructor must avoid making definite statements about topics upon which he lacks information.
   - D. Criterion ten. Opportunity should be provided for both instructor and student to use the tools of science, the scientific method and simple mathematics.

III. Criteria Concerning Specific Skills and Techniques
   - A. Criterion eleven. The course must provide for the student to practice the arts of communication, listening, reading, speaking, and writing.
   - B. Criterion twelve. The student should learn the basic technique of using the library as a source of information.
   - C. Criterion thirteen. The student may need to be taught the basic skills in mathematics necessary to the field of study.
   - D. Criterion fourteen. Where possible, the student should be taught a few of the basic skills of the profession.

IV. Criteria Concerning Basic Attitudes and Abilities
   - A. Criterion fifteen. The student should be shown the value of keeping an open mind.
   - B. Criterion sixteen. The student should learn how authority and freedom each affect learning.
   - C. Criterion seventeen. The student must be able to engage in critical thinking and to exercise judgment.
   - D. Criterion eighteen. The student should be given an opportunity to feel that he, too, can make a contribution to science. This may permit him to express his creative abilities.

A compilation was made of concepts usually found in physical and historical geology courses. A five-member panel, including the writer, applied the above criteria to the list of concepts in order to select concepts to be included in the course. This panel was selected on the basis of their familiarity with both general education and geology.

Of the above criteria, the first group was found to be most useful for selecting course content, while the others serve as a guide for individual instructors and may be useful for selecting content in specific instances only. The

course must satisfy all criteria for the goals of general education to be approached.

Finally, the writer organized the course according to the logic of the subject matter. The chosen concepts were indicated as "preferred" or "desirable." Those deemed unnecessary by the panel were omitted.

Microfilm $2.75; Xerox $7.00. 147 pages.

THE RELATIONSHIP OF CERTAIN RELIGIOUS ATTITUDES TO ARTISTIC BEHAVIOR

(Order No. Mic 61-2396)

James Peter Roy, Ed.D.
The Pennsylvania State University, 1961

Statement of the Problem

The purpose of this study was to measure the relationship of religious attitude, as a personality variable, to those aspects of artistic behavior that deal with perceptual preference and creative performance.

Procedure

The population tested consisted of one hundred and sixty-five subjects divided into the following three groups:

The Experimental Group of Elementary Education Majors:

This group consisted of eighty undergraduate students majoring in elementary education. It was used to evaluate the various measures used in the main study.

The Validation Group of Elementary Education Majors:

This group consisted of sixty undergraduate students majoring in elementary education. It was used for the main study.

The Validation Group of Art Education Majors:

This group consisted of twenty-five undergraduate students. It was used for the main study because it possessed a considerably higher degree of art training and experience. For this reason it served in determining the relationship of art experience and training to the problem under investigation.

The measurement of the individual subjects in each of the three groups as to their religious attitudes was accomplished by the Religious Concepts Inventory. The items that comprised the inventory were concerned, for the most part, with conservative or liberal attitudes toward God, Christ, the Church, and the Bible. According to their expressed beliefs concerning these items, each of the subjects was placed on a continuum that ranged from religious conservatism on the one end to religious liberalism on the other.

The Inventory of Beliefs (Authoritarian-Equalitarian Scale) was administered to each of the subjects to measure the relationship of authoritarian-equalitarian tendency to religious attitude.

A Picture Preference test, consisting of twenty-four reproductions of various art forms pre-judged as being either conservative or liberal in style and content, was used to measure the relationship between religious attitude and perceptual preference.

The art scale of the Welsh Figure Preference test was used to measure the relationship of religious attitude to preference for abstract drawings.

Two motivated crayon drawings, one dealing with religious subject matter and the other with secular subject matter, were created by each of the subjects and used for measuring the relationship of religious attitude to creative performance. The two drawings were judged separately for their degree of over-all aesthetic quality and for their degree of over-all conservative quality.

Conclusions

1. A significant relationship exists between religious attitudes and authoritarian-equalitarianism trends. Religious conservatism is concomitant with authoritarianism. Coefficients of correlation for the three groups are respectively: .54, .55, and .55. All are significant at levels beyond the 5% level of confidence.
2. A significant relationship exists between religious attitudes and preferences for art forms. Religious conservatism is concomitant with preference for art forms defined as conservative. Coefficients of correlation for the three groups are respectively: .57, .54, and .41. All are significant at levels beyond the 5% level of confidence.
3. A significant relationship exists between religious attitudes and preferences for abstract drawings of the Welsh Figure Preference measure. Religious conservatism is concomitant with preference for drawings defined as conservative. Coefficients of correlation for the three groups are respectively: .44, .51, and .49. All are significant beyond the 5% level of confidence.
4. No relationship was found to exist between religious attitudes and either the over-all aesthetic quality or the over-all conservative quality of the creative performance.

Microfilm $2.75; Xerox $6.40. 134 pages.

RELATIONSHIPS BETWEEN DIFFICULTY LEVELS OF ASSIGNED TEXTS AND READING ABILITY OF ELEMENTARY SCHOOL PUPILS

(Order No. Mic 61-2540)

Helen Burke Truher, Ed.D.
University of Southern California, 1961

Chairman: Professor Naslund

This study was designed to investigate classroom provisions for individual differences in reading ability among elementary school pupils who were being instructed according to recommendations of basal reading programs.

The Gilmore Oral Reading Test, the California Reading Test, the Informal Reading Inventory, and an informal phonics test were administered to 210 pupils in grades two, four, and six who had been chosen at random from the district used in this study. According to scores on the oral reading tests, pupils were categorized as inferior, average, or superior readers within each grade. Accuracy and comprehension of oral reading in basal reading

texts were recorded. All assigned textbooks were analyzed by readability formulas. Each of the 139 teachers of selected pupils was questioned regarding practices in assigning reading materials.

Findings and Conclusions. (1) Authoritative opinion concerning the matching of reading materials to the individual pupil's reading level apparently is not being implemented in the classroom. This may be the case because of problems involved in appraising reading achievement and in estimating difficulty levels of texts. (2) For Inferior Readers significant differences were found in pupil placements when assigned reading texts were compared with both oral test and informal inventory scores. For Average Readers significant differences were found between readability levels of reading texts and pupil scores on the silent reading test. For Superior Readers readability levels of reading texts were significantly lower than pupil scores on any of the tests used. (3) Assigned reading texts were read orally by Inferior Readers with an average of 14 errors in 100 words, by Average Readers with an average of 4 errors, and by Superior Readers with an average of 1 error in 100 words. (4) Inferior Readers scored higher in comprehension of oral reading than either of the other groups. (5) Published placements for most assigned textbooks matched the school grades in which pupils were enrolled. (6) Mean readability levels of basal texts were not significantly different from mean published grade recommendations, but individual books differed in placement by more than two school years. (7) Some pupils had been assigned texts in content areas which had difficulty levels more than three years above the levels of their reading texts. (8) High correlation was found between phonics ability as measured and scores on the standardized tests. (9) Half of the 139 teachers included in the study stated that difficulty levels of reading texts were not suitable for individual pupils. The necessity of using texts adopted and distributed by the state was most frequently cited as the reason for this difference. (10) Oral reading was mentioned by 93 per cent of teachers as an important diagnostic measure, but standards for desirable accuracy differed. (11) Two-thirds of the teachers disagreed with the criteria of the Informal Reading Inventory for the instructional level.

Recommendations. (1) Research is needed to determine the degree of accuracy and comprehension with which pupils make maximum progress in reading. (2) Research is needed in methods of teaching reading which would differentiate instruction within reading groups when all the pupils have been assigned the same text. (3) Research is needed so that results of standardized tests may be more useful in grouping pupils and in assigning texts. (4) Further research in pronunciation of nonsense syllables as related to reading ability would be valuable. (5) Reasons for comprehension difficulties should be more clearly established. (6) Research is needed in devising readability formulas which employ the criterion of accuracy of oral reading as well as that of comprehension of silent reading. (7) Teachers should be better informed about uses of readability formulas and regarding laws relating to assignment of state texts. (8) Textbooks should not be assigned to individuals only according to scores on tests or published grade placements. Microfilm $6.75; Xerox $23.85. 529 pages.

THE EFFECTIVENESS OF CERTAIN SUPERVISORY PRACTICES ON PUPIL ACHIEVEMENT IN GRADES 7, 10, AND 12 OF THE SOCIAL STUDIES CLASSES OF THE BALD EAGLE AREA SCHOOLS.

(Order No. Mic 61-2408)

Sidney Blair Willar, Ed.D.
The Pennsylvania State University, 1961

Purpose

In this study the approach was to determine the effect, if any, of classroom supervision on pupil achievement. The study attempted to determine if supervision of instruction improved pupil achievement, and the extent to which it was possible to improve instruction.

Method of Research

The study involved approximately 500 pupils on the 7th, 10th, and 12th grade levels. These pupils were matched in Experimental and Control Groups in terms of age in months, sex, I.Q. scores, and grade placement.

The teachers involved in the experiment were equated on the basis of education, sex, and level of experience in the courses used in this study.

The experiment was conducted in two parts with a full year elapsing between each part. Each part of the experiment was conducted over the period of one semester.

Pre and post tests were administered on each grade level to determine the improvement in achievement during each experimental period. The tests used in the experiment were the COOPERATIVE SOCIAL STUDIES TEST, THE COOPERATIVE WORLD HISTORY TEST, and THE COOPERATIVE AMERICAN GOVERNMENT TEST.

To determine the extent of pupil growth during the experimental periods, the t ratio formula for correlated samples was used. A correlation between post test scores and final grades assigned to the pupils by the teachers of the groups was also used to determine the effectiveness of the grading techniques.

During the experimental periods, the author performed such supervisory tasks for the Experimental Groups as classroom observations, assisting with lesson planning, and curriculum work, securing needed instructional materials, and other related supervisory activities.

Results

In the majority of the groups used in the study, the t ratio indicated the supervision as utilized in the experiment had a positive effect on pupil achievement. Data obtained from the correlation of teacher grades and post test results indicated favorable results for the Experimental Groups over the Control Groups.

Conclusions

1. From the data assembled and examined in this study, and under the conditions this study was conducted, the supervisory practices used had a positive effect on the achievement of the pupils used in the Experimental Groups of this study.

2. The effectiveness of the supervision varied from group to group in relation to the understanding and cooperative interest of both teacher and supervisor.

Microfilm $2.75; Xerox $7.60. 164 pages.

ENGINEERING, GENERAL

THE NATURE OF INDIVIDUAL DIFFERENCES IN BODILY FORCES EXERTED DURING A MOTOR TASK AS MEASURED BY A FORCE-PLATFORM

(Order No. Mic 61-2456)

James Walter Barany, Ph.D.
Purdue University, 1961

Major Professors: James H. Greene and
Harold T. Amrine

The objective of the study was to investigate the general characteristics of the individual differences in the amount of bodily movement exerted during the performance of a simple motor task. The experimental task consisted of placing a stylus into two holes forty inches apart. Bodily movement was ascertained by the amount of force exerted in the transversal direction as measured by a force-platform.

Three groups of ten subjects performed the experimental task with different sets of instructions. The instructions were designed to influence the amount of conscious control exerted by a subject over his force pattern.

The experimental findings indicated that:

(1) Instructions stressing speed of performance resulted in the least amount of variation in performance between trials.

(2) Instructions stressing the minimization of bodily movement per unit of output led to some confusion on the part of the subjects.

(3) The subjects possessed a significant degree of conscious control over their force patterns. The forces exerted were reduced by as much as three times the original value by merely changing the work method.

(4) If the instructions concerning work methods were held constant, up to 80 per cent of the variation in the amount of bodily movement was attributed to individual differences.

(5) There was no appreciable relationship between the average amount of bodily movement and the number of units produced.

(6) There was no significant relationship between anthropometric measurements and the amount of force exerted or the number of units produced.

(7) The time scores for the Ziegler version of the Minnesota Rate of Manipulation Test did not correlate significantly with forces exerted or number of units completed. However, the forces exerted during the test were linearly related to the forces exerted during the experimental task at the 0.05 level.

(8) Several subjects expressed a subjective feeling of being "tired" after completion of the portion of the experiment calling for the minimization of bodily movement, thereby casting some doubt on the feasibility of using the measure of bodily movement as the ultimate criterion for job performance.

In general, the findings verify the contentions of previous investigators that work methods comprise a major portion of the individual differences observed in the performance of motor tasks. With the use of the force-platform, the inherent individual differences along with the variations in work methods were quantified. Therefore, the force-platform offers a technique for the study of individual differences in job performance as well as determining the most efficient method of doing muscular work.

Microfilm $2.75; Xerox $6.20. 127 pages.

INFORMATION CONCEPTS IN WORK ANALYSIS

(Order No. Mic 60-6769)

Donald Kenneth Ross, Sc.D.
Washington University, 1960

Chairman: Dr. Gerald Nadler

The hypothesis is advanced that a useful measure of task difficulty is achieved if the information contained in all perceptual dimensions of the task is summed. When the task requires a decision that is a function of external risks and utilities, decision difficulty is obtained by multiplying the information by a factor that depends upon the average sample number of the appropriate decision model.

A great deal of background material, both theoretical and experimental is accumulated and interpreted to support the hypothesis. Calculations are made using experimental data from the literature to prove the internal consistency of portions of the hypothesis.

Results have also been obtained which show good agreement between job difficulty measurements made by Information Content Analysis and more conventional Job Evaluation techniques.

Microfilm $2.75; Xerox $9.70. 211 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

ENGINEERING, AERONAUTICAL

TORSIONAL STIFFNESS OF NON-UNIFORMLY HEATED CANTILEVER PLATES FOR ANY ASPECT RATIO AND INITIAL TWIST

(Order No. Mic 61-2822)

Delmar Wallace Breuer, Ph.D.
The Ohio State University, 1961

The decrease in torsional stiffness of cantilever plates due to a chordwise temperature variation is investigated both theoretically and experimentally. The temperature is assumed to be constant through the plate thickness and along the span. The primary object of the study is to find a solution which holds in the short-to-long plate regime and under conditions of large deflections and initial twist. The Von Karman plate equations for large deflections are solved approximately by means of a variational principle developed by Reissner. The principle is applied specifically to plates of solid rectangular cross-section and rectangular plan form. A stress function of the form

$$F = C_1 f_1(x) f_1(y) + C_2 f_2(x) f_1(y) \qquad (1)$$

and a displacement function of the form

$$W = C_3 f_3(x) f_2(y) \qquad (2)$$

are assumed, with the functions defined so that the boundary conditions on the stress and the displacement are satisfied. The application of the variational principle provides the value of the constants C_1, C_2, and C_3.

It is shown that the results can be expressed in the form

$$\phi - \phi_i = m + \lambda\phi - \phi(\phi^2 - \phi_i^2) \qquad (3)$$

and

$$(\omega/\omega_0)^2 = 1 - \lambda + 3\phi^2 - \phi_i^2 \qquad (4)$$

where ϕ is a non-dimensional twist angle and ϕ_i is the initial value of this angle, m is a non-dimensional twisting moment, λ is the ratio of the temperature difference between the mid-chord and the edge to that value required to produce torsional buckling in a flat plate, ω is the natural torsional frequence under conditions of variable temperature and twist, and ω_0 is the natural torsional frequency of the flat plate with a uniform temperature.

Equations (3) and (4) are verified experimentally for plates having length to half-width (a/b) ratios of 2, 3, 4, 5, 6, 7, and 8 and for varying values of initial twist. It is shown that these results are applicable for temperature distributions which are both symmetrical and asymmetrical with respect to the mid-chord axis of the plate. Finally, it is shown how these results may be applied to plates of variable thickness.

Microfilm $2.75; Xerox $6.00. 123 pages.

STUDY OF THREE-DIMENSIONAL SUPERSONIC FLOW PROBLEMS BY A NUMERICAL METHOD BASED ON THE METHOD OF CHARACTERISTICS (SPECIALLY ADAPTED FOR USE ON HIGH SPEED ELECTRONIC DIGITAL COMPUTERS)

(Order No. Mic 61-1673)

Cheng Chih Tsung, Ph.D.
University of Illinois, 1961

Three-dimensional supersonic flow problems governed by the nonlinear partial differential equation for the velocity potential with specified initial and boundary conditions can be solved by numerical calculation procedures based on the method of characteristics. Utilizing finite difference equations derived on characteristic surfaces along two characteristic directions, unit processes for the iterative numerical calculation of field points and solid boundary points were formulated.

For the unit process of the field point calculation, given the flow conditions at three points 1, 2, 3 which form a triangle on a non-characteristic surface, the location (x_4, y_4, z_4) and flow condition $(M^*_4, \theta_4, \psi_4)$ at point 4 can be calculated by finding the point of intersection of three inner characteristic surfaces and solving their corresponding characteristic equations. For the unit process of the solid boundary point calculation, where two of the given three points are lying on the boundary surface, the location and flow condition at point 4 can be calculated with the additional conditions that the point 4 has to be on the solid surface where the velocity vector must be tangent to the solid surface.

These unit processes can also be adapted to give elementary solutions for centered wave regions and conical flow fields. Thus entire flow fields pertaining to three-dimensional supersonic flow problems may be constructed with the given initial and boundary conditions. The utilization of these numerical calculation procedures for establishing entire flow field is discussed in detail.

Only the availability of high speed digital computers makes it practical to apply the present numerical calculation procedure for solving particular supersonic flow problems.

Special codes have been developed for the high speed electronic digital computer ILLIAC, at the University of Illinois.

Specific examples for the application of the present method of calculation are given, namely potential flow over a delta wing with supersonic leading edge and potential flow past a conical boattail with elliptic cross section. Results of these numerical calculations on the ILLIAC are discussed and compared with other available solutions. In the case of the delta wing, the pressure distributions as calculated by the present method for two different free stream Mach numbers and four different angles of attack, showed much better agreement with the available experimental data than those obtained by the linearized method. For the special case of a supersonic flow past an elliptic conical boattail, where the major and minor axes of the base ellipse are equal, the results of the present method agreed well with the well established results for axially symmetric flow field.

Particular attention was given to the effect on the accuracy of results by the selection of mesh size and mesh shape. Microfilm $2.75; Xerox $5.00. 100 pages.

ENGINEERING, AGRICULTURAL

CHARACTERISTICS OF FLOW IN IRRIGATION FURROWS

(Order No. Mic 61-1942)

John Rowland Davis, Ph.D.
Michigan State University, 1959

Major Professor: E. H. Kidder

The efficient use and distribution of irrigation water is predicated upon a knowledge of the behavior of water flow in irrigation systems. Unfortunately, the interactions of flowing water, soils and crops have been difficult to analyze; resulting in a general inability to express these interactions quantitatively and accurately. Only recently have researchers become aware of the need for more precise designs and descriptive mathematical tools, and have been encouraged to study the basic variables and fundamental principles of the hydraulics of surface irrigation systems. This study was an attempt to describe or define some of the hydraulic aspects of flow in irrigation furrows, to contribute to a better understanding of furrow irrigation and the ultimate achievement of more efficient use of water.

The basic variables involved in this probmem were (1) the infiltration phenomenon, and (2) flow regimes in small earth channels. Considerable achievements have been made in the field of infiltration and flow of water through soils, but the effects of the geometry of a furrow irrigation system have been only superficially investigated. Studies to date have indicated that furrow shape and depth of water affect infiltration rates and wetting patterns to a considerable degree.

The characteristics of non-uniform flow in a channel with erosive boundaries have not been studied to any extent, except for some work on furrow erosion. Several workers have attempted to define or predict flow of water in irrigation borders, but these methods have met with varying degrees of success.

The most critical part of a furrow system design is the rate of advance of water down a furrow, for this affects not only the distribution of water but also the erosion hazard, the water requirement of the system, and the operation and management of the system. The main purpose of this study was the development of a mathematical expression for rate of advance and a description of the variability of the individual components of this expression.

The rate of advance equation, based on a conservation of mass, was developed and applied to field measurements at two locations in California during the 1958 irrigation season. These locations represented two distinctly different soil types and cropping systems. Data from other workers were also used to discern whether or not the equation would prove satisfactory with limited measurements.

Comparisons of observed and calculated rate of advance showed that the equation was capable of predicting rate of advance accurately under a variety of conditions. The fact that the equation could be used successfully to describe the flow in a furrow was significant in itself, but the fact that the equation also designated the relative importance of the variables involved was of great importance.

Studies of furrow infiltration in a sand model resulted in the conclusion that furrow geometry and water depth affected the infiltration rate considerably. Although infiltration was correlated with water depth, the relative potency of such parameters as wetted perimeter and top width was much greater than that of water depth. Furrow spacing was not correlated with infiltration rate.

Field measurements with the Hamilton furrow infiltrometer indicated that this instrument might be useful in describing infiltration from a furrow; but that the change in furrow shape, the movement of water and sediments in a flowing furrow, and the seasonal effects may alter any relationships appreciably.

Studies of furrow shape at Davis, California, indicated that furrow shape is likely to be a function of soil texture and structure and the flow rate. Generally, higher flow rates created a flatter bottom in a furrow; which did not change during subsequent irrigations. Furrow shape and hydraulic roughness appeared to be related. This led to the hypothesis that a furrow channel may conform to a certain shape or attain a certain hydraulic radius and area depending on the flow rate. Should this be a valid hypothesis, it would then become possible to predict the shape and size of a furrow as affected by flow rate and seasonal variation in roughness, for any soil condition. This would result in an even more practical and widespread use of the rate of advance equation.

The rate of advance equation developed should prove an extremely valuable tool for the design and evaluation of furrow irrigation systems. It will certainly promote a better understanding of the flow characteristics of furrows and should stimulate further research in the fundamental aspects of surface irrigation hydraulics.

Microfilm $2.75; Xerox $6.60. 137 pages.

DYNAMIC STRESS TRANSDUCERS AND THE USE OF CONTINUUM MECHANICS IN THE STUDY OF VARIOUS SOIL STRESS-STRAIN RELATIONSHIPS

(Order No. Mic 61-1170)

Wesley Lamar Harris, Ph.D.
Michigan State University, 1960

Major Professor: Wesley F. Buchele

The changes in soil consolidation resulting from externally applied forces and the effect of these changes on the physical properties of the soil have been studied by many individuals. The results of one of the investigations revealed that the concept of continuum mechanics could be used as a mathematical model for studying the soil compaction problem. The development of soil stress-strain relationships which will permit the prediction of the changes in the state of compaction caused by various implements and power units will be a major contribution toward controlling soil compaction.

The concept of continuum mechanics was used to determine various stress-strain relationships. A Six Directional Stress Transducer capable of measuring sufficient data to determine the components of the general stress tensor was developed and compared with the method used by Vanden Berg (1958). A W Cell capable of measuring mean stress directly was developed and the values of mean

stress calculated from the Type A and 6 DST data were compared.

The data from a series of 27 tests of 5 replications composed of three depths below the loading surface, three moisture contents and three rates of loading are presented. The data was analyzed using MISTIC, an electronic digital computer, to determine the relationships between the invariants of the stress tensor and bulk density.

The hypothesis that changes in mean normal stress, an invariant of the stress tensor, are related to changes in volumetric strain was tested by measuring the stress tensor and bulk density in the soil while the soil was subjected to dynamic loads of various magnitudes. Based on the data presented, the hypothesis could not be accepted or rejected. The data indicated that of the four invariants of the stress tensor investigated the maximum shear stress related best to changes in bulk density.

The relationships between the invariants and bulk density were affected by the moisture content at the higher rate of loading and deeper depths. The rates of loading data was varied; therefore the effects on the relationships could not be determined.

The values of mean stress obtained directly from the W Cell compared best with the values calculated from the Type A data. Comparison of the two methods of measuring vertical stress with theoretical values determined with Froehlick's equation showed good agreement with the Type A values at the two deeper depths. For the 5-inch depth, both the 6 DST and Type A data were greater than the theoretical data for a given surface load.

The relationships between the invariants and bulk density are exponential for the soil studied. The relationship between mean stress and applied load appears to be linear for loads greater than 5 pounds per square inch.

Microfilm $2.75; Xerox $9.00. 200 pages.

A THEORETICAL ANALYSIS OF THE DECAY OF SECONDARY FLOW FOLLOWING A PIPE BEND

(Order No. Mic 61-1961)

Cornelius Chung-sheng Shih, Ph.D.
Michigan State University, 1959

Major Professor: E. H. Kidder

This study was initiated with the suggestion that theoretical analysis of decaying secondary flow after the bend may contribute some information for the improvement of water distribution over the field by rotary irrigation sprinklers. The equations of motion and the continuity equation together with some assumptions and boundary conditions have been used to express the flow condition in the pipe, and were solved for the case of laminar flow.

The general solutions are expressed as asymptotic functions associated with the initial flow conditions at the entrance of the pipe.

Since the length of the transition segment is the main interest in this study, it was determined by applying the general solutions. The relationships between the length of the transition segment and the intensity of the initial flow or the roughness of the pipe were presented with some calculations.

In addition, the adaptation of the solutions for the condition of laminar flow to the condition of turbulent flow was attempted with a hope that the tendency in the relationships for turbulent flow can be assessed.

By using these relationships, the distances of transition segments were theoretically calculated on the basis of assumed sprinkler characteristics and flow conditions.

Microfilm $2.75; Xerox $3.00. 48 pages.

INTERPRETATION AND MEASUREMENT OF STRAINS IN WOOD

(Order No. Mic 61-2516)

John Neal Walker, Ph.D.
Purdue University, 1961

Major Professor: A. C. Dale

The primary purpose of this study was to investigate the two major obstacles which have prevented the successful application of stress analysis techniques to wood structural units. They were the inability to obtain accurate and reliable strain data and the non-elastic behavior of wood. The problems, which first had to be investigated, were those associated with the measurement of strains in wood. In particular, the following sources of error in strain measurement were investigated: transverse sensitivity effects, drift due to gage current, effect of changes in the ambient temperature, and the effect of a source of radiant energy. These factors were investigated for wire grid, foil grid and single wire electric resistance gages oriented both parallel and perpendicular to grain.

The results of the transverse sensitivity tests showed that there were no significant differences between the outputs of the various types of gages except when the gages were oriented parallel to the direction of the grain in wood and when the loads were applied perpendicular to the grain. For this condition the wire grid gages showed practically no response; whereas, the foil grid and single wire gages showed the same approximate magnitude of strain in Tuckerman optical gages.

The remaining tests on sources of error in strain measurement permitted the plotting of thermal drift curves for 30-minute time intervals. All of the sources of error were of sufficient magnitude to indicate a definite need for compensation techniques. Since thermal drift due to the various sources of error was not linear with respect to time, an individual compensating gage is required for each active gage. The data were also analyzed to determine the magnitudes of drift which would occur when compensating techniques are used. This analysis showed that all of the sources of error which were investigated could be effectively minimized by rigorous compensating techniques except the errors due to a source of radiant energy whose intensity was equivalent to the intensity of bright sunlight.

To determine the applicability of elastic relationships, three sets of tests, each giving rise to a different state of stress, were performed. These tests were: tension parallel to grain, flexure where the state of stress was evaluated

in the extreme fibers, and flexure where the state of stress was evaluated along the neutral axis. The faces on which the stresses were evaluated were approximately parallel to a principal orthotropic plane. It was found through these tests that either the equations which apply to the orthotropic planes of an orthotropic material or the more general equations which apply regardless of the orientation of the axes of reference gave essentially the same results.

When experimental and theoretical values for the longitudinal stress in the tension and flexure tests were compared, it was observed that considerable discrepancy existed between the two values. A comparison of the elastic constants obtained from compression calibration tests and the tension and flexure tests showed that the modulus of elasticity parallel to grain differed by 21.4 per cent for the tension tests and 37.5 per cent for the flexure tests. However, when the compressive and tensile moduli were determined from flexure tests, the moduli when the face was in compression averaged 3.6 per cent less than the moduli when the face was in tension. The flexural tests where the state of stress was evaluated on the neutral axis showed that the calibration procedures developed for evaluating the elastic constants gave values which permitted evaluation of the shear stress from the strain data.

The calibration procedures yielded values for all of the elastic constants in the general elastic relationships for orthotropic materials. Theoretically, the constants appearing in these equations should be symmetrical, i.e., A_{ij} should be equal to A_{ji}. This symmetry of constants was strongly contradicted. However, when these constants were used assuming symmetry existed and also when symmetry was not assumed, essentially the same results were obtained. Microfilm $2.75; Xerox $9.00. 198 pages.

HEAT AND MOISTURE PRODUCTION OF MATURE LEGHORN CHICKENS

(Order No. Mic 61-2518)

Harold Vincent Walton, Ph.D.
Purdue University, 1961

Major Professor: Alvin C. Dale

There has been a genuine need for basic data on the heat production of chickens as influenced by environment. Accordingly, this study was initiated with the following objectives:

1. To devise a suitable method for measuring the latent component of the heat produced by chickens.
2. To measure the components of heat loss from mature Single Comb White Leghorn chickens (convection, radiation, and latent) as influenced by environment.
3. To develop prediction equations which can be used by engineers to calculate the heat and moisture load to be dealt with in designing for environmental control in laying houses for Single Comb White Leghorn chickens.

A direct calorimeter was assembled for this study in which sensible heat flow was metered by a gradient layer thermopile and radiant heat transfer was metered by a 4-Pi radiometer or radiation thermopile. Latent heat data were obtained by gravimetric methods. Incoming air was saturated by passage through a vat of crushed ice and exhaust air was dried chemically.

An experimental design was selected which permitted the consideration of chicken weight and environmental temperature as important influencing variables. Runs were made at temperatures of 55F, 62.5F, and 70F. Chicken weights were selected in three groups. One group was below the flock average; one group was above the flock average; and one group was about the flock average of 4.15 pounds per chicken. Measurements were made on a total of 27 chickens. This gave three replications with the above 3 x 3 design.

Data were collected for a 24-hour period for each chicken, and these data were analyzed statistically. Multiple regression techniques yielded the following prediction equation for estimating total sensible heat production (Q_s) in BTU per hour per chicken.

$$Q_s = 30.80 + 4.45\,w - 0.38\,t + 0.08\,f$$

In this equation, w is the chicken weight in pounds, t is environmental temperature in degrees Fahrenheit, and f is feed consumption in grams per day. The use of this equation should be restricted to Single Comb White Leghorn chickens, a weight range of 3.5 to 4.8 pounds, a temperature range of 55F to 70F, and a feed consumption of 100 grams or less per day.

Radiant heat transfer (Q_r) and latent heat production (Q_l) were independent of the above measured variables. Average values for these heat quantities on a per chicken basis were determined as follows:

Q_r = 13.65 BTU/hr.

Q_l = 3.49 BTU/hr.

The average radiant heat transfer for these chickens represented 47% of the average total sensible heat production. The average latent heat production represented 10.7% of the average total heat production.

The system which was used in this study for measuring latent heat production had some shortcomings. It did not provide sufficient reproducibility and was troublesome to manage. A satisfactory technique for measuring latent heat production must still be developed.

Microfilm $2.75; Xerox $5.20. 104 pages.

ENGINEERING, CHEMICAL

SURFACE EFFECTS ON THE LOW TEMPERATURE GASIFICATION OF CARBONS

(Order No. Mic 61-2349)

Alton Fearing Armington, Ph.D.
The Pennsylvania State University, 1961

The primary purpose of this work was to attempt a correlation between the surface area and reactivity of

carbons using lower temperatures and lower burn-offs than usually employed in studies of carbon reactivity. The work was performed with a vacuum microbalance system in which weight changes of 3×10^{-7} gram can be detected. Two types of carbons were used in this work. Seven graphitized carbon blacks of different surface area represented one type of carbon while four ground and regraphitized graphites represent a different type of carbon surface. These carbons were reacted both in carbon dioxide and oxygen at 0.1 atmospheres pressure.

For each type of carbon a correlation between surface area and reactivity was found both for samples reacted in oxygen at 600°C., and samples reacted in carbon dioxide at 900°C. However, no relationship was found when the reactivity of both carbons was correlated against surface area. An attempt was made to calculate the theoretical active sites of both types of carbon and to correlate the reactivity against the calculated active site concentration, regardless of the type of carbon. Results indicate that a qualitative estimate of the reactivity can be produced from such calculations for ash-free non-porous carbons.

The reaction order and the activation energy of the carbon-oxygen and carbon-carbon dioxide reactions were also investigated in this work. The carbon-oxygen reaction had a reaction order between 0.5 and 1 with an activation energy of about 55 kcal./mole for the conditions employed in this work. The carbon-carbon dioxide reaction was zero order under the conditions employed with an activation energy of about 85 kcal./mole.

Calculations indicate that some of the experiments performed were affected by diffusion. The effect of ash-content on reactivity was not studied.

Results indicate that hydrogen pretreatment was more effective than vacuum pretreatment in producing reproducible rates on duplicate runs. The oxygen reaction is apparently less sensitive to the condition of the surface since reproducible results were obtained regardless of pretreatment.

Microfilm $2.75; Xerox $6.20. 130 pages.

THE EFFECT OF MASS TRANSPORT ON THE CARBON-CARBON DIOXIDE REACTION

(Order No. Mic 61-2350)

Leonard George Austin, Ph.D.
The Pennsylvania State University, 1961

The possible mechanisms of the carbon-carbon dioxide reaction have been discussed. A thermodynamic argument is applied to results from the literature and it is concluded that the mechanism of reaction is probably

$$C_f + CO_2(g) \rightleftarrows C(O) + CO(g)$$

$$C + C(O) \rightarrow CO(g) + C_f$$

The concepts of surface potential and its change with chemisorption of gas on a surface have been used to derive new rate equations for the chemisorption or desorption of gases on solids. The rate equations give a general isotherm which, under certain conditions, has the form of the Freundlich isotherm. Under conditions where saturation of the surface by chemisorbed gas does not much change the dielectric constant of the surface condenser, the general isotherm reduces to a Temkin isotherm, while the rate equation reduces to the Elovich equation. Further, if no charge separation occurs on chemisorption, or if the active sites are only a few per cent of the surface, the general isotherm reduces to the Langmuir isotherm.

It is suggested that the kinetics of graphitization follow an Elovich rate law.

The current theories of the effect of mass transport on reaction rates have been reviewed and extended to cover the case of cylindrical geometry. An analysis has been made of experimental results obtained by Rusinko (106). He investigated the non-uniformity of reaction through cylindrical carbon samples of 1/2 inch diameter. Making no assumptions regarding the mechanism of reaction it is shown that the different modes of mass transport within the solid will have only minor effects on the rates of reaction. Furthermore, the results indicate that the true form of rate equation is of the form

$$\frac{dn}{dt} = \frac{k_1 p_{CO_2}}{1 + k_2 p_{CO} + k_3 p_{CO_2}}$$

This kinetic equation is that most commonly proposed for the carbon-carbon dioxide reaction.

On the basis of existing theories of the effect of mass transport on reaction rates, several major anomalies were found in the experimental results. Reaction through the rods was found to be non-uniform at rates of reaction well below those necessary to give significant reduction of carbon dioxide concentration within the solid. The apparent order of reaction with respect to carbon dioxide concentration was found to be one half. This would normally be taken as meaning the true reaction order was zero in the diffusion controlled region. In addition, the shape of the Arrhenius plot did not fit existing theories.

Although the rate constants k_1, k_2, k_3 in the above equation are not known for the carbon studied, rate constants for a similar type of carbon were taken from the literature. Using the values, the combined chemical rate-mass transport rate equation for a plane of carbon was solved numerically, for conditions similar to those used experimentally, using the true form of rate equation given above rather than the m order reaction generally used in such solutions. It was found that the retardation effect due to carbon monoxide build-up within the solid was sufficient to explain all of the anomalies discussed above.

It seems probable that low temperature activation energies of 70-100 kcal/mole are not single activation energies, but may represent a combination of activation energies of k_1, k_2, and k_3, even if the carbon dioxide concentration is almost uniform through the sample studied. Probably the only sure way to determine the rate constants is by adding sufficient carbon monoxide to ensure known concentrations of carbon monoxide and then to analyze the system for the three rate constants.

It is concluded that the pronounced effect of small amounts of carbon monoxide at low temperatures causes the existing criteria for calculating the effects of mass transport on reaction rates to break down entirely for the case of the carbon-carbon dioxide reaction.

Microfilm $2.75; Xerox $9.00. 199 pages.

A STUDY OF THE STRUCTURE OF TURBULENT SHEAR FLOW IN PIPES

(Order No. Mic 61-2117)

William Alfred Brookshire, Ph.D.
Louisiana State University, 1961

Supervisor: Professor Dale U. von Rosenberg

The present status of knowledge of turbulent shear flow in pipes is inadequate for the formulation of a general theory. It is felt that more experimental data and the subsequent interpretation of these data will be necessary before a workable theory can be formulated. It is to this end that this research was conducted.

The experimental studies were carried out in a 40 foot length of schedule 40 aluminum pipe which was preceded by a large calming box. The turbulence quantities and mean velocity were measured with a constant temperature hot wire anemometer.

The choice of a pipe as a test section is an excellent one as it yields turbulence that is homogeneous in two directions. This homogeneity greatly simplifies the Reynolds equations for turbulent pipe flow. It is shown by the Reynolds equations and the boundary conditions that there is a definite tendency toward isotropy at the pipe center, i.e., $\overline{uv} = \overline{uw} = \overline{vw}$ and $w' = v'$. The only condition lacking for isotropy is $u' = v'$ and the data of Laufer[13] show that this condition was satisfied in his test equipment.

In this research mean velocity and axial intensity of turbulence were measured at twelve different Reynolds numbers varying between 4,800 and 201,000. At each Reynolds number measurements were made at twenty-seven points distributed almost logarithmically with respect to distance from the wall. Axial dissipation length was measured at the same points as mean velocity and axial intensity; however, the minimum Reynolds number in the dissipation length studies was 81,800. Azimuthal intensity and correlation between the azimuthal and axial fluctuating velocity were measured at eight Reynolds numbers varying between 39,800 and 201,000. These measurements were made only in the turbulent core.

The axial and azimuthal intensity of turbulence are a minimum at the pipe center and, in the turbulent core, increase almost linearly as the pipe wall is approached. The axial intensity reached a maximum very near the wall at a dimensionless distance, Y^+, of about 15. At Reynolds number of 4,800 and a distance from the wall of 0.0025 inches no turbulence was detectable. This is, to the knowledge of the author, the only experimental evidence of a true laminar sublayer in turbulent flow.

Oscillograms of the axial fluctuating velocity, very near the wall, showed velocity spikes (sharp increases in velocity) similar to those observed by von Rosenberg[25] in parallel flat jets.

The axial dissipation length measurements were a maximum near the pipe center and decreased to a minimum near the pipe wall. These measured dissipation lengths were nearly independent of Reynolds number except in the region near the wall where dissipation length decreased with increasing Reynolds number.

The mean velocity data correlated well with the logarithmic velocity distribution for $Y^+ > 30$ and with $U^+ = Y^+$ for $Y^+ < 6$. A second equation, derived by Pai,[18] was compared to the mean velocity data. This equation gave excellent agreement in the turbulent core and for $Y^+ < 4$, but showed deviations up to 20% in the outer edge of the transition region. Pai's equation has the virtue of satisfying the Reynolds equations which the logarithmic velocity profile does not.

The axial intensity of turbulence written in dimensionless form was found to be a function only of Y^+ for $Y^+ < 7$ and for $Re > 20{,}000$, this result may be extended to $Y^+ \sim 40$. In the turbulent core u'/U^* and w'/U^* appear to be primarily a function of radial position and only slightly a function of Reynolds number.

Microfilm $2.75; Xerox $7.60. 162 pages.

A KINETIC STUDY OF THE CHLORINATION OF UNBLEACHED KRAFT PULP

(Order No. Mic 61-2230)

Vasant Dinkarrao Chapnerkar, Ph.D.
The University of Florida, 1961

An investigation was made of the chlorination of pulps with a view to study the mechanism of lignin removal and the pulp degradation. The individual effects of chlorine concentration, chlorination time and temperature on the rate of delignification were also evaluated.

When the pulp was chlorinated under conditions of falling concentration, increases in pulp consistency and initial chlorine concentration increased the total chlorine consumption, as well as the consumption of chlorine by substitution. For every gram of lignin removal, the Kraft pulp consumed about 1.30 grams of chlorine. The heat of reaction of the Kraft pulp and chlorine was found to be 360 BTU/# of the pulp treated. The heat of reaction of the Kraft pulp and sodium hypochlorite was found to be 375 BTU/# of the pulp treated.

Two chlorination stages of short time duration with immediate alkali extraction removed more lignin than a single chlorination stage of a time equal to the two chlorination stages. This indicated that the incrustations of chlorinated products formed on the fiber hinder further reaction and hence should be removed.

When the Kraft pulp was chlorinated under conditions of constant chlorine concentration and temperature, it was found that constancy of reaction rates was attained at higher chlorine concentrations. The delignification data for the Kraft pulp after chlorination and for chlorination followed by alkali extraction fit very well an equation based on two apparent simultaneous or consecutive first order reactions. In addition to the lignin removed by these two apparent reactions, a certain percentage of the original lignin was assumed to be removed instantaneously. The reaction velocity constants for both the apparent first order reactions have been shown to vary with chlorination temperature in accordance with the Arrhenius equation.

For the same quantity of lignin removed at different concentration levels, it was found that the degree of polymerization number of the cellulose was lower at higher concentrations. However, it was also indicated that at very short-time intervals the decrease in the degree of polymerization number at higher concentration levels was not appreciable.

The rate of delignification of cold soda pulp was a function of chlorine concentration and no constancy of reaction rates was found. Thus, it was the concentration of lignin in the Kraft pulp and not the concentration of chlorine which was the controlling factor. The delignification data fit well an equation similar to that derived for the Kraft pulp. The apparent reaction velocity constants for both the reactions were logarithmic functions of the chlorine concentration. It was found that the values of the percent of the original lignin remaining calculated for the Kraft pulp through the use of equation derived for the cold soda pulp were much higher than those observed.

A microscopic study of both the cold soda pulp and the Kraft pulp indicated that the ratio of surface to weight for the cold soda pulp was considerably less than the Kraft pulp.

It was concluded that in chlorination of pulps, the exposed surface is an important variable. Therefore, an attempt should be made to incorporate this variable in the general equation derived for delignification by chlorination.

Microfilm $2.75; Xerox $7.40. 157 pages.

AN INVESTIGATION OF THE HOT SURFACE DRYING OF GLASS FIBER BEDS

(Order No. Mic 61-2452)

Wavell Frederick Cowan, Ph.D.
The Institute of Paper Chemistry,
affiliated with Lawrence College, 1961

Chairman: S. T. Han

An investigation was made of the hot surface drying of a glass fiber bed. Glass fibers were selected for study because they form porous beds with a relatively simple pore structure which remains unchanged during the drying process. Internal moisture gradients during controlled hot surface drying were obtained by use of a beta-ray technique; internal temperature gradients were obtained by the use of fine-wire thermocouples; the internal pore structure was investigated with a capillary pressure technique.

An examination of the experimental data in relation to a derived mathematical model supports the concept of the existence during the constant rate period of a zone of condensation within the fiber bed adjacent to the hot surface, and a zone of evaporation near the open or air interface. The description of drying which is most consistent with this concept is that water which evaporates at the hot surface interface diffuses back through the bed under the influence of the partial pressure gradient. In the zone of condensation the diffusion is accompanied by continual condensation. However, at some point in the fiber bed the partial pressure falls below that required to saturate the available air space and at all subsequent positions to the air interface the diffusing vapor is supplemented by internal evaporation.

The over-all drying rate is thus the result of evaporation of water from three sources; viz. (1) water which evaporates at the hot surface interface and diffuses back through the zone of condensation, (2) water which evaporates internally from the zone of evaporation, and (3) water which evaporates from the air interface.

The falling rate period for the glass fiber bed commences when liquid water disappears from the hot surface interface. Evaporation at the interface therefore ceases and the zone of evaporation expands to eliminate the zone of condensation. Thereafter the over-all drying rate is the result of internal evaporation and evaporation from the open surface.

The qualitative picture was supplemented by a quantitative evaluation of the experimental data. This evaluation was developed as a means of investigating the factors which affect heat transfer, evaporation, water vapor diffusion, and liquid flow inside the fiber bed during drying.

Microfilm $2.75; Xerox $8.00. 171 pages.

ION EXCHANGE IN TERNARY SYSTEMS

(Order No. Mic 61-1985)

Joshua Simon Dranoff, Ph.D.
Princeton University, 1960

This thesis presents the results of an experimental and theoretical investigation of cation exchange in ternary systems. This is considered to be a first step in the comprehensive study of the problem of multicomponent ion exchange and should serve as a basis for future work in this area.

The plan of attack was to break down the over-all problem into the component problems of the equilibria and kinetics of ion exchange systems and to examine these component areas first. The results of such separate studies were then combined in the analysis of the practical but more complex problem of transient column operation.

(1). Following the work of previous investigators on the behaviour of binary systems, and the previous work of this author concerning the equilibria in ternary systems, a study was made of the kinetics of ternary ion exchange reactions. Two different systems were used with the reaction carried out in a batch stirred reactor. The resultant experimental data were compared with a theoretical analysis based on the assumption that the various ion pairs which constitute the system undergo reactions of a second order reversible type. The experimental and computed results agreed within the precision of this work. It was therefore concluded that the second order rate equations for the system were valid and useful.

(2). The operation of a fixed bed ion exchange column with a ternary system was also investigated. Experiments in shallow beds and deep beds were performed, with the shallow bed data used to obtain effective rate constants for the rate equations under column conditions. These rate constants varied with solution flow rate in a fashion similar to that reported previously for binary cation systems.

(3). The deep bed data were compared with results predicted by the descriptive differential equations derived for the ternary system fixed bed exchange, using rate constants obtained in the shallow beds. The data for several runs made in rather short beds agreed with the computed results within the precision of this work.

(4). Because of the highly non-linear nature of all of the theoretical equations, it was necessary to use a high-speed digital computer, the IBM 704, for computation. Consideration was given to problems of stability and convergence of the equations as well as to the numerical techniques employed.

(5). It was concluded that the behaviour of a fixed bed ion exchange reactor could be satisfactorily analyzed using the rate equations previously utilized so successfully for binary systems. Although the numerical techniques developed in this work were valid for the ternary systems studied, further work along these lines is necessary before such computations can be carried out successfully for fixed beds of practical size and significance.

Microfilm $3.85; Xerox $13.50. 297 pages.

SOME THEORETICAL AND EXPERIMENTAL ASPECTS OF GAS-LIQUID PARTITION CHROMATOGRAPHY

(Order No. Mic 61-1864)

James Ellis Funk, Ph.D.
University of Pittsburgh, 1961

A mathematical model for gas-liquid partition chromatography, called the lumped film model, which accounts for a gas phase resistance to mass transfer, molecular diffusion in the liquid phase, a certain type of nonlinear solubility, column pressure drop, and axial diffusion in the vapor phase has been developed. In the development it has been assumed that the liquid phase in the chromatographic column exists as a thin uniform film which can be treated as a lumped system. The two describing partial differential equations are nonlinear and have variable coefficients and were solved numerically by finite differences using an IBM 704 digital computer program. A simple expression for the apparent retention time was obtained under the assumptions of constant pressure, linear solubility, and no axial diffusion in the gas phase. This expression yields an apparent retention time which is half that given by the equilibrium model, which assumes instantaneous equilibrium between the liquid and vapor phases, under similar assumptions.

Experimental data were obtained on an empty column, a column packed with dry glass spheres or dry firebrick, and a column packed with coated glass spheres or coated firebrick. Helium was used as the carrier gas, isobutylene was the solute, and narcoil was the stationary liquid phase. The apparent retention time from the lumped film and equilibrium models was compared with experimental data and it was found that for coated glass spheres the lumped film model deviated from the data by +14 to +17% whereas the equilibrium model deviated by -66 to -72%. For coated firebrick the lumped film model deviated from +17 to +43%; the equilibrium model deviated from -13 to -66%. Approaching the problem from a "penetration" theory viewpoint resulted in an equation which was used to correlate the data. The data for each individual coated bed were very well correlated and the data from the same bed at three different temperatures were correlated with an accuracy of ± 7%. It was also found experimentally that the apparent retention time was affected by the size and concentration of the feed sample. This effect has been noticed before and is not predicted by either the lumped film or the equilibrium models.

The elution curve from one of the coated glass sphere experiments was compared with an elution curve predicted by the computer program. The computer and experimental elution curves peak at the same time although the computer peak mole fraction is 0.74 whereas the experimental curve peaks at a mole fraction of 0.50. The computer curve is skewed in the same direction as the experimental curve although to a much lesser degree.

It is concluded that the lumped film theory applies well to the coated glass spheres, where it is expected that the liquid phase does actually exist as a thin film. It is felt that no general conclusion can be drawn about the coated firebrick experiments; in some cases the lumped film model applied better, in others the equilibrium model gave better agreement.

Microfilm $2.75; Xerox $9.00. 200 pages.

A PHENOMENOLOGICAL APPROACH TO THE BATCH GRINDING OF COALS

(Order No. Mic 61-2368)

Robin Pierce Gardner, Ph.D.
The Pennsylvania State University, 1961

The problem of this study was to develop and demonstrate a valid phenomenological approach to the unit operation of batch grinding. To this end the grinding process was considered to be defined by a selection function, S, and a distribution function, B, as employed and defined in the following derived partial differential equation of batch grinding:

$$P(y,r) = P(y,0) + \int_0^r \int_y^{x_m} \frac{\partial P(x,r)}{\partial x} S(x)\, B(y,x)\, dx\, dr,$$

where $P(y,r)$ = the percentage of material less than size y at r revolutions of the grinding machine,

x_m = the maximum particle size in the grinding charge,

$S(x)$ = the selection function, defined as the fraction by weight of material of size x broken per revolution of the grinding machine,

and $B(y,x)$ = the distribution function, defined as the fraction by weight of the breakage product of particles of size x which become smaller than size y on breakage.

The problem of applying this approach was then to measure the S and B functions over a range of particle sizes and grinding durations, and to demonstrate the validity of the approach by solving the above equation using these experimentally measured functions to reproduce the experimental size distributions.

The two problems encountered in applying a phenomenological approach of this type are: (1) the problem of being able to quantitatively describe what happens to the particles of a given size when they are mixed with particles of all sizes, and (2) the problem of being able to

solve the derived partial differential equation of batch grinding.

The first of these problems was solved by utilizing a radioactive tracer technique. Individual size fractions were removed from the grinding charge by sieving. These fractions were irradiated in a nuclear reactor and remixed with the original grinding charge. After a certain grinding duration, the grinding charge was sized; the amount of irradiated material in each size fraction was determined by using a standard Geiger-Müller tube counter. In this way the grinding properties of particles of various sizes could be separated from the grinding properties of the total grinding charge and the S and B functions could be measured for various particle sizes and grinding durations.

The second problem was solved by devising a numerical solution to the derived batch grinding equation and programming this solution for a digital computer.

The selection and distribution functions were measured for three coals (two anthracite and one high-volatile bituminous) as ground on the standard Hardgrove Grindability Machine. Particle sizes in the range of 44 to 1190 microns were studied for each coal. Both of these functions were found to follow the same trends for all three coals. The selection function varied directly with particle size. It could be represented by a power law with size in the size range of from 520 to 1190 microns. The distribution function was independent of grinding duration and original particle size and dependent only on the y/x ratio for each coal. The lower portion of the distribution function less than y/x = 0.65 could be represented by a power law in y/x. These results are summarized in the Table below.

SUMMARY OF EXPERIMENTAL RESULTS

Coal	Rank	Hardgrove Grindability	Selection Function, from y = 520 to y = 1190 microns (fraction broken per revolution)	Distribution Function, from y/x = 0 to y/x = 0.65
A	Anthracite	30	$6.15 \times 10^{-10} y^{2.67}$	$0.492(y/x)^{1.31}$
B	Anthracite	51	$3.43 \times 10^{-11} y^{3.14}$	$0.728(y/x)^{1.30}$
C	High-volatile bituminous	84	$3.36 \times 10^{-10} y^{2.81}$	$1.000(y/x)^{1.10}$

The calculated size distributions using these experimental functions at grinding intervals of 10, 20, 30, and 60 revolutions fit the experimental size distributions over the entire range of particle sizes for all three coals. The maximum departure between the calculated and experimental size distributions was less than 4 per cent units. This agreement indicates that the technique is valid and reasonably accurate. The forms of the experimental selection and distribution functions indicate that practical correlations with the ground material and grinding machine will be possible using the proposed technique.

Microfilm $2.75; Xerox $7.00. 147 pages.

HEAT AND MOMENTUM TRANSFER IN THE INCOMPRESSIBLE BOUNDARY LAYER ON A FLAT PLATE

(Order No. Mic 61-2478)

Owen Titus Hanna, Ph.D.
Purdue University, 1961

Major Professor: Dr. John E. Myers

This investigation was conducted to gain new analytical knowledge about heat and momentum transfer in boundary layer flow past a flat plate for situations where the classical Blasius and Pohlhausen solutions are not applicable.

A new form of the analogy between heat and momentum transfer is derived. The results are in agreement with the solutions of the boundary layer equations already known for the case of laminar flow of high Prandtl number fluids, and they have been extended in an approximate manner to include variations of kinematic viscosity and thermal diffusivity with temperature. This analogy also yields results for turbulent flow, including the effect of a sublayer, which are in substantial agreement with the few data available.

An integral solution is given for the case of laminar boundary layer flow past a plate for the case of a temperature dependent viscosity. The solution is valid for non-isothermal friction factors for liquids. Heat transfer coefficients are presented for liquids. The results indicate that the essential nonisothermal parameters are: (a) the ratio of the variation of viscosity with temperature at the wall to the viscosity at the wall, (b) the temperature difference between wall and free stream, and (c) the Prandtl number at the wall.

An integral analysis is made for the problem of heat transfer past a rough plate with a step temperature profile at the wall. Assuming a zero pressure gradient outside the boundary layer, but a non-zero pressure gradient close to the wall, the analysis indicates that (a) the effect of the Prandtl number is the same as for a smooth plate, (b) it is not correct to use the smooth plate analogies by simply using the friction coefficient based on skin drag only, and (c) with increasing roughness, the friction coefficient increases at a faster rate than the heat transfer coefficient.

Three new step wall temperature solutions are given for heat transfer from a flat plate. The three cases considered are (a) laminar flow of non-Newtonian fluids, (b) laminar flow of liquid metals, and (c) turbulent flow of liquid metals. The effect of the start of heating length, ξ, in all three cases is represented by the well known factor

$$\left[1 - \left(\frac{\xi}{x}\right)^{\delta}\right]^{-\alpha}$$

These solutions are of some interest in themselves, but their primary importance is in the solution of problems involving arbitrary wall temperatures. For non-Newtonian fluids, the constant δ was found to be related to n in the expression $\tau_{xy} = K(\partial u/\partial y)^n$. For turbulent flow of liquid metals, both δ and α depend on m, where $(t - t_w)/(t_\infty - t_w) = (y/\delta')^{1/m}$.

The problem of heat transfer from a flat plate for a step wall heat flux is studied, and concise results are presented for the following cases: (a) laminar flow for $N_{Pr} > 1$, (b) laminar flow of non-Newtonian fluids, (c) laminar

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

flow of liquid metals, (d) turbulent flow for $N_{Pr} > 1$, and (e) turbulent flow of liquid metals. It was found that the effect of the unheated starting length ζ for these fluid systems was accounted for by the simpler expression

$$\left[1 - \frac{\zeta}{x}\right]^{-\alpha}$$

For corresponding systems, the values of α are the same for both step wall temperature and step wall heat flux. It is seen that the step wall heat flux solutions are basically simpler than the step wall temperature solutions, since the former are characterized by one parameter (α), while the latter depend on two parameters (δ,α).

A technique for superposition of step wall heat flux solutions in the case of arbitrary wall heat fluxes and temperatures has been outlined. General results have been given, so that specific situations are easily considered. A numerical comparison of step wall temperature and step wall heat flux superposition shows that they yield practically identical results. It is found that step wall heat flux superposition affords a considerable simplification in the solution of problems involving specified wall heat fluxes.

Microfilm $2.75; Xerox $7.40. 157 pages.

EFFECTS OF SONIC VIBRATIONS ON THE RATE OF ABSORPTION OF GASES FROM BUBBLE BEDS

(Order No. Mic 61-1868)

Kenneth Lee Harbaum, Ph.D.
University of Pittsburgh, 1961

A 3 inch diameter glass column was operated as a bubble type gas absorber by providing for counter-current flow of water and CO_2. Vibrations in the range 20 to 2500 cycles/sec with a maximum power of 4 watts were transmitted directly into the bubble bed from an electrodynamically driven vibrator. The flow rates, bubble bed height, pressure, and temperature were controlled and the rate of absorption of the CO_2 in the water was measured as a function of frequency and sonic input power. The results showed that the gas absorption efficiency was significantly improved at certain resonant frequencies which were dependent upon the amount of liquid present in the column. The improvement in gas absorption rate at these resonant peaks was due primarily to the large increase in the amount of CO_2 holdup in the bubble bed.

Microfilm $2.75; Xerox $6.60. 139 pages.

INDIVIDUAL MASS TRANSFER RESISTANCES IN LIQUID-LIQUID EXTRACTION

(Order No. Mic 61-2282)

Sung Ho Hong, Ph.D.
University of Missouri, 1961

Supervisor: Gerhard H. Beyer

Individual film resistances in mass transfer were determined for the methyl isobutyl ketone-water system in a 4-inch I.E. spray column. Column height was varied from one to four feet. Individual film resistances (as H.T.U.) and individual capacity coefficients (ka) were measured by passing the two partially miscible liquids countercurrently through the column. The degree to which each stream approached saturation at the exit served as a measure of each film resistance. By presaturating one of the liquids, a unidirectional mass transfer was obtained and the operating procedure simplified.

The outlet concentrations leaving the column were converted into ka's and H.T.U.'s, and analyzed as functions of flow rate and column height. The variation of individual mass transfer coefficient, k, with flow rate was also studied by assuming constant droplet size and constant rate of droplet fall or rise in the column. A tentative correlation of mass transfer rate with the physical properties of the liquid system such as density, viscosity, interfacial tension, and molecular diffusivity, was proposed.

The individual capacity coefficient of the dispersed phase film, $k_d a$, varied linearly with the dispersed phase flow rate, but was practically independent of the continuous phase flow rate. The individual capacity coefficient of the continuous phase film, $k_c a$, was a function of the flow rates of both phases.

The effect of flow ratio on $(H.T.U.)_d$ and $(H.T.U.)_c$ was correlated by the Colburn and Welsh type equations,

$$(H.T.U.)_d = C_1$$

$$(H.T.U.)_c = C_2 (V_c / V_d)^n$$

where C_1, C_2, and n are constants, characteristics of the liquid system. For the methyl isobutyl ketone-water system, C_1, C_2, and n were 1.75 feet, 2.78 feet, and 0.75, respectively, for water, and 1.05 feet, 1.85 feet and 0.70, respectively, for methyl isobutyl ketone, at column heights of two to four feet and flow ratios, V_c/V_d, greater than unity. When the flow ratios were less than unity, n was 0.54 for water and 0.53 for methyl isobutyl ketone. The exponent n seemed to be a function of the flow ratio, V_c/V_d.

The individual mass transfer coefficient of the dispersed phase, k_d, appeared to be independent of the flow rates of both phases. The individual mass transfer coefficient of the continuous phase, k_c, varied with the flow rates of both phases, approaching a constant at higher flow rates of either phase.

End effects were noticeable at a column height of one foot, but became less significant at heights of two feet and above. The end effects tended to decrease H.T.U. and to increase ka.

The correlation of mass transfer rate with the physical properties of the system was tentative, awaiting further accumulation of data from other systems with different physical properties.

Microfilm $2.75; Xerox $7.00. 149 pages.

THE HYDRATION OF MAGNESIA

(Order No. Mic 61-2383)

George Kavanaugh Layden, Jr., Ph.D.
The Pennsylvania State University, 1961

The rates of reaction of carefully sized MgO powders with water vapor at various temperatures and pressures are determined gravimetrically.

The appropriate mathematics for the analysis of experimental data for phase boundary limited and diffusion limited reactions is presented, and a formula is derived on the basis of irreversible thermodynamics for the pressure dependence of the hydration reaction, viz.

$$\upsilon = LR\ \ell n(p/p_o) \qquad (1)$$

where υ is the chemical reaction rate,

L, a rate coefficient,

R, the gas constant,

p, the reaction pressure,

and p_o, the dissociation pressure of $Mg(OH)_2$.

The nucleation of $Mg(OH)_2$ on MgO when exposed to water vapor at conditions where $Mg(OH)_2$ is the stable solid phase is strongly dependent upon the pressure relative to saturation. The subsequent hydration reaction is found to be phase boundary limited and the chemical reaction rate is determined for various conditions of temperature and pressure. The reaction rate as a function of temperature and pressure is given by the equation

$$\upsilon = L_o\ R\ \ell n(p/p_o)\,.\exp(-Q/RT) \qquad (2)$$

where L_o is a constant, and Q is an activation energy given by the empirical formula

$$Q = 17{,}011 + 1552(1-p/p_s)-471(1-p/p_s)^2$$

$p_o = 0.312\ p_s$ is the dissociation pressure of $Mg(OH)_2$ at temperature T as reported by Johnston.

P_s is the saturation pressure of water vapor.

Since it is probable that Johnston's data represent adsorption pressures rather than true equilibrium pressures it is suggested that at relative pressures above 0.312 the primary reaction mechanism involves the participation of the adsorbed water phase as a transport medium, and that below this pressure adsorption is insufficient to support this mechanism and reaction then proceeds by a comparatively slow solid state process.

Microfilm $2.75; Xerox $4.60. 86 pages.

EVALUATION OF SULPHUROUS ACID AS A LEACHING AGENT FOR OXIDIZED LOW GRADE NICKEL ORES

(Order No. Mic 61-2302)

Leandros Philip Lenas, Ph.D.
North Carolina State College, 1961

Supervisor: Edward Martin Schoenborn

Sulphurous acid has been evaluated as a leaching agent for oxidized low grade nickel ores. This evaluation involved a study of the effect of operating variables, pretreatment, and effect of valueless metals present on both the nickel extraction and the acid consumption. Comparison was made with results obtained in corresponding runs using sulphuric acid. A procedure for separation of the various metal values in the leach solution and a typical sulphurous acid leaching process have been proposed.

Oxidized low grade nickel ores differing widely in composition were leached with aqueous solutions of SO_2 under pressure in an Aminco super-pressure vessel. The results indicated that sulphurous acid shows definite promise as a leaching agent for such ores. More than 90% of the nickel in these ores can be extracted with sulphurous acid at 212°F and 38 psig pressure in a period of 3 hrs. Thus, sulphurous acid can compete with sulphuric acid, since for approximately the same quantities of nickel extracted, less total ore is dissolved and appreciably lower acid consumption is obtained by a sulphurous acid leach. Operating variables such as time and temperature appreciably affect the amount of nickel extracted and the acid consumption. Pretreatment of the ores, such as oxidizing, reducing, and sulphatizing improves the nickel recovery. By the regulated addition of MgO to the extract, iron and nickel values can be precipitated leaving the magnesium in solution.

The proposed sulphurous acid leaching process for oxidized low grade ores shows considerable promise when the by-product MgO is used as a precipitant for the metals in the extract, when a portion of the pH adjusted final solution is recycled, and when available SO_2 from the final extract and residue are recovered for reuse.

Microfilm $2.75; Xerox $7.20. 155 pages.

MASS TRANSFER AND VELOCITY OF RISE PHENOMENA FOR SINGLE BUBBLES

(Order No. Mic 61-1878)

James Howard Leonard, Ph.D.
University of Pittsburgh, 1961

A series of experiments has been carried out to measure the mass transfer rate and accompanying rise velocities for single bubbles of various gases in certain dilute aqueous solutions. The basic experimental method consisted of creating a single bubble of gas in a liquid-filled column which was completely closed except for a single capillary tube. The creation and subsequent absorption of the single gas bubble was observed as a displacement of the liquid meniscus in the capillary, giving a measure of the bubble volume as a function of time. By suitable interpretation of the bubble volume behavior, a measure of the mass transfer rate was obtained. By combining these data with a simultaneous measure of the rise velocity of the bubble, the following conclusions were drawn.

Mass transfer and rise velocity phenomena were found to be characterized by two specific regions which correspond to a bubble equivalent spherical diameter less than and greater than 6 mm., respectively. Above this transition point, the mass transfer rate is mainly dependent upon the velocity of rise of the bubble. The rise velocity is in turn dependent only upon the bubble size.

Below the transition point, certain specific effects on rise velocity were observed. The velocity of a gas bubble

in a liquid is limited by that of an insoluble bubble rising in pure water. Rise velocity is inversely related to the absolute rate of mass transfer across the gas-liquid interface, regardless of direction, subject to certain limitations. This relationship is destroyed by the addition of nitric acid to form a solution of pH 0.7. The relationship is suppressed by the addition of a surface active agent to the liquid. The mass transfer-rise velocity relationship does not exist during a short time interval immediately following bubble release, where all bubbles exhibit the velocity of insoluble bubbles.

The mass transfer rate for bubbles in the regime below 6 mm. equivalent diameter exhibits a strong dependence upon the time elapsed after bubble release. This effect is less pronounced the higher the velocity. The most satisfactory model for correlating the mass transfer results is based upon an "atmosphere" concept which supposes the bulk liquid to be well agitated so that the bulk concentration exists everywhere up to an interfacial film, or atmosphere. The thickness of the film is inversely related to the rise velocity.

The mass transfer and rise velocity phenomena investigated in this work, as well as in that of several other investigators, are explainable by a hypothesized model involving the dynamic, continuous formation of multilayers of polar molecules at the bubble surface.

Microfilm $2.75; Xerox $7.80. 166 pages.

A STUDY OF PULSATILE FLOW PHENOMENON

(Order No. Mic 61-1135)

Robert Guild Linford, Ph.D.
University of Utah, 1961

Chairman: Norman W. Ryan

The purpose of this project was to examine critically the theoretic equations derived for pulsatile flow in rigid straight tubes. These equations, presented in their most useful form by Womersley in 1955 (42, 43), give the fluid flow rate as a function of the pressure gradient-time relationship, pulse frequency, fluid properties, and tube radius, and they give the fluid velocity as a function of the above quantities plus the radial position in the tube.

A pulsatile flow apparatus was constructed which would provide a known flow rate in a straight rigid tube and which would allow the measurement of the pressure gradient-time and velocity profile-time relationships, the fluid properties, and the tube radius. A computer was used to calculate the fluid flow rate and velocity profile from the pressure gradient-time relationship, fluid properties, and tube radius, by means of Womersley's equations, thus allowing a check between measured and calculated values of flow and velocity. It was found that the calculated results agreed with the measured values of flow and velocity in both amplitude and phase within the experimental measurement error of six per cent. A procedure was then developed for the reverse process, calculating the pressure gradient from a given pulsatile flow rate.

The exact solution of the Navier-Stokes equation for pulsatile flow by Womersley was compared with the approximate solution of Fry, et al. (6, 7). The comparison showed that the approximate solution never deviates by more than 20 per cent in amplitude or phase from the exact solution.

An attempt was made to apply the criterion for the onset of turbulent flow developed by Ryan and Johnson (34), but it was found that the present form of the criterion does not apply to pulsatile flow.

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Microfilm $2.75; Xerox $7.20. 152 pages.

A STUDY OF SOME TRANSIENT CONDITIONS IN CONTINUOUS BINARY DISTILLATION OPERATIONS

(Order No. Mic 61-2238)

Frank Pierce May, III, Ph.D.
The University of Florida, 1961

This dissertation reports the results of a study made of the transient response of compositions in a continuous distillation column, when subjected to step changes in reflux ratio. The main object of this work was to test the validity of both the mathematical model, which was set up to describe the process, and the calculation procedure devised to calculate transient response data from this model. The model not only makes use of empirical equations to represent equilibrium, enthalpy-concentration, and plate efficiency data, but also avoids assumption of constant internal flow rates. Thus, for the first time a realistic comparison has been made between experimental and computed results for step changes in reflux ratio.

The basic model was reduced to working form for a binary component system by making a number of assumptions, including: (1) negligible vapor holdup, (2) constant plate holdup on a mass basis, and (3) perfect mixing in all stages of the column. The simplifying assumptions were found to be adequate for the experimental system used in this investigation, and are known to be frequently applicable in commercial practice.

Transient response data, showing excellent reproducibility, were obtained with the experimental equipment using methanol and tertiary butyl alcohol as the binary system.

Satisfactory calculated response data were predicted by means of a numerical calculation procedure carried out on an IBM 650 digital computer. Although disagreement between calculated and experimental results was small – 4% or less – it was concluded that these deviations could probably be reduced by using more accurate constants in the empirical auxiliary equations. The good agreement between calculated and experimental transient response curves validates both the mathematical model and the calculation procedure.

Consideration was also given to the possible use of changes in reflux ratio to compensate for changes in feed composition in order to maintain essentially constant product composition. It was concluded that for such a scheme to be feasible, it would be necessary to program the computer with an adequate mathematical description of the dynamic changes which would occur under these conditions.

The results of this investigation are felt to be a step forward in providing the type of information which will be required to make computer "pilot plant studies" a reality.

Microfilm $2.75; Xerox $9.00. 198 pages.

THE UNSTEADY STATE DIFFUSION OF GASES FROM ANTHRACITE AT HIGH TEMPERATURES

(Order No. Mic 61-2391)

Eric Thompson Nelson, Ph.D.
The Pennsylvania State University, 1961

An experimental technique has been developed for measuring the unsteady state molecular flow of gases from relatively impermeable materials at high temperatures. By using a balanced system with respect to room temperature and furnace temperature fluctuations, it has been possible to measure the rates of release of small volumes of gas such as are encountered under thermal conditions unfavorable to gas adsorption. The apparatus has been shown to be capable of providing results which are in good agreement with the theory.

Two new computation techniques have been developed for evaluating diffusivities from experimental results. It has been demonstrated that the computational methods which have been available up to the present time are oversimplified, that they are incomplete in the sense that indirect means are required for evaluating one of the most important parameters involved and that, as a result, they can lead to misinterpretation of experimental data. It has been shown that the "small time" solution to the differential equation for unsteady state diffusion in a spherically symmetrical medium leads to an improved graphical method for evaluating low diffusivities. A digital computer program has been developed for evaluating higher diffusivities from the complete classical solution to the diffusion problem.

Values of the parameter $D_{\frac{1}{2}}/r_o$ (where D is the gas/solid diffusivity and r_o is the equivalent radius of a typical particle) have been obtained for the diffusion of gases from 65 X 100 mesh and 200 X 325 mesh samples of a Pennsylvania Anthracite in a temperature range where no data have been obtained up to the present time. In contrast to the results obtained at low temperatures by previous investigators, it has been shown that gas diffusion rates from anthracite at high temperatures do not possess any significant exponential dependency upon temperature.

Attempts to investigate the effect of diffusion rate upon particle size produced no conclusive results owing to the fact that the material was found to possess a two-pore system. The effect of diffusion rate upon heat treatment was investigated and found to give rise to a decrease in accessibility with increasing heat treatment temperature.

Microfilm $2.75; Xerox $7.60. 161 pages.

DISLOCATIONS IN SINGLE CRYSTAL SAPPHIRE AS REVEALED BY THERMAL ETCHING

(Order No. Mic 61-2303)

Hayne Palmour III, Ph.D.
North Carolina State College, 1961

Supervisor: William Wurth Kriegel

A procedure for thermal etching of sapphire is described by which microstructural surface features related to dislocations, subgrain boundaries and twin lamellae are developed. Thermal etching of previously oriented, cut, and polished sapphire surfaces is carried out in protective alumina enclosures over the range 1500 – 1900° C, with a preferred firing treatment being one hour at ~ 1900° C in an oxyacetylene fired furnace.

The mechanisms responsible for the development of thermally etched surfaces are described as (1) surface annealing by diffusion processes in the 1500 – 1750° C range, (2) etching by sublimation of an aluminous vapor phase from sub-grain boundaries at as low as 1500° C and from surfaces at ~ 1750° C, and (3) surface decoration of dislocation termini by aluminous material condensing from a supersaturated vapor phase during cooling from the etching temperature.

The thermal etching technique is utilized in (1) characterizing the local inhomogeneities in as-grown sapphire boules (2) studying dislocation distributions in flame-bent and bent-and-polygonized sapphire rod specimens, and (3) demonstrating that untwinned sapphire exhibits orientation anisotropy of basal dislocations, which lie as an oriented bundle with one preferred Burgers vector. Plastic, rather than brittle, deformation behavior related to edge dislocation motion in the direction of the one existing Burgers vector is suggested as an explanation for the pronounced microindentation brittleness anisotropy noted on basal planes for untwinned crystals.

Parallel linear patterns on thermally etched surfaces on other crystals are interpreted as evidence of twin lamellae slightly tilted with respect to (0001). Such tilted twinning planes are described as noncoherent, being made up of sections of coherent twin boundary, parallel to (0001), connected by twinning dislocations. Non-brittle deformation as a result of glide along coherent twin boundaries by twinning dislocations having a preferred Burgers vector is suggested as an explanation for the microbrittleness anisotropy determined by indenting approximate basal surfaces showing twin lamellae.

By the thermal etching technique, sapphire is

demonstrated to be a relatively imperfect material containing irregularly distributed dislocations and many subgrains tilted or twisted with respect to one another. The impurities present in various grades of sapphire have shown some slight influence on the texture, but not the substantive character, of thermally etched surfaces. Impurities may, however, play important roles in the growth processes which determine the types of structural defects observed.

It is concluded that the thermal etching technique represents an improvement over earlier methods for detection of dislocations in sapphire, particularly in its ability to resolve individual basal dislocations on prism planes and screw dislocation termini on basal planes, and to demonstrate the presence of twin lamellae. The data obtained by thermal etching methods are regarded as being in excellent agreement with existing knowledge of basal twinning, basal dislocations and growth spiral screw dislocations, and are not inconsistent with published data concerning prismatic dislocations.

Microfilm $2.75; Xerox $6.40. 133 pages.

EVALUATION OF COMMERCIAL DELIVERIES OF SUGAR CANE

(Order No. Mic 60-5925)

Biraja Bilash Paul, Ph.D.
Louisiana State University, 1960

Supervisor: Professor Arthur G. Keller

The primary objective of this study was to develop a practical and efficient method for determining the quality of an individual bundle or consignment of sugar cane as a basis for payment to the growers. Quality considerations that were sampled and tested were pol, purity, and fiber of the cane.

Samples of sugar cane that are representative of the quality factors and are small enough for processing by current methods are very difficult to obtain because of the highly variable character of commercial bundles of sugar cane. Sampling methods evaluated (which included the present method for comparative purpose) were the (1) 6-stalk, (2) 10-stalk, (3) 32-stalk quadrant, (4) single mechanical grab, and (5) composite mechanical grab sampling methods. These sampling methods were tested intensively and over a period of three years. In addition, a core method of sampling was devised and tested during the period of two grinding seasons.

Reliability of two methods of processing the samples was tested – the Farrel Mill was deemed adequate and selected because of its consistency and dependability, and the chipping-Waring Blender method was eliminated for its lack of reliability and precision.

The commercial mill results for a given bundle of cane were considered as standard basis of quality (true measurement of the quality of the individual consignment).

The results of the different sampling methods were compared with the results obtained by grinding the remainder of the bundle of sugar cane on the commercial tandem of the Audubon Sugar Factory at Louisiana State University.

By studying variations in can quality factors occurring in an area of sugar cane that could reasonably produce a bundle of commercial cane, it was found that variance between the sample results and mill results could reasonably have been due to variation in quality within the sample and not necessarily due to the sampling method.

For all practical purposes, none of the sampling methods tested were found superior to the other sampling methods being used.

The core sampling method was developed and was used during the 1958-59 and 1959-60 grinding seasons. Experiments as to coring positions revealed no significant difference in results as to positions of the bundle that was sampled. Two positions (one core sample near each of the two chains) were considered to be the most suitable points for removing the core.

The proportion of fiber in cane is not used as one of the quality factors entering into the price determination for sugar cane. Although judgment and logic indicate that amount of fiber should be considered in determining price, and although fiber content of cane was tested as one of the quality factors, no specific value or weight for fiber was attempted.

From the analysis of the correlation coefficient, it was found that the ratio $(\text{Fiber}/\text{Pol})_{\text{cane}}$ is a good index for the measure of quality of the sample. The ratio $(\text{Fiber}/\text{Pol})_{\text{cane}}$ close to unity is a qualitative measure of the quality of cane sample. Two equations were developed and it was found that the equations are quite valid within the range of the variability of the observed data.

Microfilm $2.90; Xerox $10.15. 224 pages.

INDIVIDUAL PHASE BEHAVIOR IN LIQUID-LIQUID EXTRACTION

(Order No. Mic 61-2241)

Forrest Lynn Poska, Ph.D.
The University of Florida, 1961

Because of the increased understanding of system and equipment behavior, liquid-liquid extraction has become one of the most important of the unit operations. However, adequate data for design purposes have been meager due to the lack of a method for analyzing the behavior of the mass-transfer coefficients of the two phases when solute transfer occurs. Information from previous methods of analysis based on the mutual saturation of a two-phase, two-component system could not be extended to a three-component system because of the dependence of the individual-film mass-transfer coefficient on the physical properties of the system. With the introduction of the pulse column, the mutual saturation approach was unsuccessful as the two phases saturated prematurely due to the high degree of turbulence caused by pulsation.

In this study, a method was developed to determine the effects of pulsation and flow rates on the kinetics of liquid-liquid extraction via the development of information concerning the behavior of individual-film mass transfer coefficients. This method makes possible the determination of individual-film mass-transfer coefficients from over-all mass-transfer data obtained with two systems having effectively equal diffusivities. The column used in

this investigation was a glass column packed with Raschig rings and the liquid was pulsed by a piston built into the lower settling section. The two systems used were water-acetic acid-methyl isobutyl ketone and water-propionic acid-methyl isobutyl ketone. The variables studied were the continuous and dispersed phase flow rates and the frequency of pulsation.

It was shown experimentally that $(H.T.U.)_{OD}$ decreases with an increase in pulse frequency from 0 to 40 cycles/min. for both three-component systems at all flow rates of both phases from 6 to 15 cu.ft./hr.-sq.ft. The decrease in $(H.T.U.)_{OD}$ is more prominent at high flow rates of the continuous phase and low flow rates of the dispersed phase. The greatest effect of pulsation was found to be on $(H.T.U.)_C$ and, correspondingly, k_Ca. In no case was the independence of $(H.T.U.)_D$ with flow rates found in this investigation. An increase in pulse frequency increased both k_Ca and k_Da with the influence of pulsation decreasing with increasing dispersed phase flow rate.

Microfilm $2.75; Xerox $6.00. 123 pages.

A STUDY OF FLUID FLOW AND MASS TRANSFER IN TRICKLE-BED REACTORS

(Order No. Mic 61-2001)

William Edward Schiesser, Ph.D.
Princeton University, 1960

Fluid flow and mass transfer in a trickle-bed were studied by means of a transient response technique. Pulse and step disturbances in tracer concentration were applied to a water stream trickling down through a 4-inch packed column. Nonporous spheres were initially used as packing in order to study the interparticle fluid flow. The column was then packed with porous spheres for an investigation of intraparticle diffusion.

The step response of the packed column indicated a close approach to plug flow. The axial mixing would be detrimental only at conversion levels of 90% or higher for a first order reaction. The liquid holdup in the column was determined as a function of flow rate by a numerical integration of the area under the step response curves. Although the operating holdup varies logarithmically with flow rate as reported by previous investigators, the total holdup does not because of the additional static holdup which is a constant independent of the flow rate for a given packing. The diffusion into and out of the static holdup was found to contribute very little to the axial mixing.

The radial variation in liquid flow rate within the packed bed was determined by using a liquid collector consisting of a series of concentric cylinders that divided the base of the column into seven equal circular areas. The commonly quoted design criterion that wall effects are negligible for $D_t/D_p > 10$ was found to be invalid for a disproportionately high flow of liquid down the wall of the column was observed for $D_t/D_p = 16$. A significant improvement in the flow profile did result, however, from increasing D_t/D_p from 8 to 16. The effluent sampling equipment was so constructed that the step response of each of the seven streams flowing from the liquid collector could be obtained simultaneously. For $D_t/D_p = 8$, the individual response curves were considerably spread out in time indicating a significant radial variation in the distribution of residence times. For $D_t/D_p = 16$, the greater uniformit in the packing density resulted in essentially a uniform response over the column cross section. The use of the smaller packing $(D_t/D_p = 16)$ therefore resulted in optimum hydrodynamical conditions within the column since both the flow profile and the distribution of residence times were significantly improved.

The step and integrated pulse responses of the column were found to be in close agreement for the nonporous packing. For the step input, the internal pores were initially filled with tracered liquid so that a relatively large quantity of tracer diffused out of the packing to produce an extended terminal response. The pulse passed through the bed too rapidly for an equivalent quantity of tracer to diffuse into and out of the packing so that the response terminated in a considerably shorter time. The column therefore had the apparent characteristics of a non-linear system (i.e. the step and integrated pulse responses were not identical) although neither the interparticle fluid flow nor the intraparticle diffusion was inherently non-linear.

Since for the step input the tracer was initially distributed uniformly throughout the porous packing, the step response provided a direct indication of the rate of diffusion within the packing. Effective pore diffusivities evaluated from step response data varied from 1.76×10^{-5} cm^2/sec for porous alumina spheres with an average pose diameter of 125,000 A to 2.35×10^{-6} cm^2/sec for molecular sieves with an average pore diameter of 4 A.

The transient characteristics of the packed column could be conveniently described in terms of a lumped-parameter model. With nonporous packing, the column behaved as a pure time delay plus a first-order transfer stage. A method was developed for predicting the corresponding transfer function from a knowledge of the liquid holdup at the operating flow rate. With porous packing, the step response of the column had the form of a pure time delay plus a second-order transfer stage. The time delay and the first time constant were determined by the interparticle fluid flow and could therefore be estimated by the same method as for the nonporous packing. The second time constant was determined by the intraparticle diffusion and could be predicted from a knowledge of the particle size and the effective pore diffusivity. A general transfer function could not be formulated for the porous packing, however, since the step and pulse responses were not equivalent.

Microfilm $2.75; Xerox $9.45. 207 pages.

POWER ABSORPTION OF BINGHAM PLASTICS IN ROTATIONAL DEVICES

(Order No. Mic 61-2002)

Robert Henry Schwaar, Ph.D.
Princeton University, 1960

Power absorption in Bingham-type non-Newtonian fluids was studied experimentally in two extreme types of rotary flow systems. Theoretical analyses to describe the results include an extension of Reynolds' additivity relation to Bingham fluids.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Experiments were performed on 1) rotational liquid flow in the annulus between two concentric cylinders, and 2) liquid flow in a baffled cylinder stirred by a rotating impeller. The smooth-walled cylinders were represented by a commercial rotational viscometer, a Fann V-G Meter. Baffled cylinders were represented by standard fully-baffled, impeller-stirred vessels.

Fluids studied were heavy suspensions in water of cement rock, of calcium carbonate, and of magnesium hydroxide. These suspensions were shown to be Bingham fluids by appropriate analyses of viscometric data taken on the Fann V-G Meter. Flow parameters, η (coefficient of rigidity) and τ_y (yield stress), also were computed from an analysis of Fann V-G Meter data.

Relations between torque, rotational speed, and the flow parameters are given in the classic work of Reiner and Riwlin for the case of a Bingham fluid in rotational flow between smooth cylinders. Three dimensionless groups,

$$(N_P)_c = \frac{P\, g_c}{\rho N^3 R_1^3 R_2 h}, \quad (N_{Re})_c = \frac{(R_2^2 - R_1^2) R_1 N \rho}{R_2 \eta}$$

$$\text{and } Z = \frac{g_c\, \tau_y R_1 \rho (R_2^2 - R_1^2)}{2\eta^2 R_2} \ln \frac{R_2}{R_1},$$

characterizing the Reiner-Riwlin equation, were used to interpret the experimental results in generalized form. These relations were compared with the analogous relations commonly encountered in pipe flow and in rotational flow, with Newtonian and non-Newtonian fluids, with smooth and with roughened surfaces, in viscous and in turbulent flow.

An extension to Bingham fluids is proposed to the "additivity law" of Reynolds for Newtonian fluids in viscous and in turbulent motion. This law states that the pressure drop (or torque) is in part proportional to the first power of velocity (or rotational speed) and in part proportional to the square of the velocity (or rotational speed). The resulting functional relationship among the resulting three dimensionless groups, $(N_P)_c$, $(N_{Re})_c$ and Z, is shown to represent satisfactorily the stirred-vessel data over the limited range studied.

The experimental validity of using composite dimensionless groups, $(N_P)_c$ and $(N_{Re})_c$, to describe the stirring of Newtonian fluids in a non-geometrically-similar series of vessels of different size, has been illustrated over a limited range of variables.

Some consideration has been given to the technique of power measurement. An overhead reaction-torque dynamometer was modified to increase the range and accuracy of torque measurements.

Microfilm $2.75; Xerox $8.00. 172 pages.

REACTION OF BITUMINOUS COAL WITH CONCENTRATED SULFURIC ACID

(Order No. Mic 61-2404)

Methratta Paul Thomas, Ph.D.
The Pennsylvania State University, 1961

The most effective utilization of coal requires that a complete knowledge of its constitution be known. It is for this reason that a large amount of effort has been expended on studying coal in the laboratory. The objective of the present investigation has been to understand the nature of the chemical reactions involved when bituminous coal is treated with concentrated sulfuric acid. In this connection bituminous coal is treated with concentrated sulfuric acid in the range of 50° to 150°C.

A small part of the carbon of the coal is eliminated by oxidation to carbon dioxide and carbon monoxide; however, the majority remains in the solid product. Carboxyl, hydrogen sulfate and sulfonic acid groups are introduced giving the product acidic properties. In addition, phenolic and carbonyl groups are introduced, and the percentage of hydrogen is reduced. Infrared spectra have shown the elimination of aliphatic carbon and hydrogen groups.

The 100° and 150°C. products contain equal amounts of hydrogen sulfate and sulfonic acid groups, but in the 50°C. sample hydrogen sulfate groups predominate. While the coal progressively loses carbon, hydrogen and sulfur with increasing temperatures, it gains more and more carbonyl, carboxyl, and phenolic groups. These changes are well demonstrated by the infrared spectra of the sulfonated coal samples.

Thus, the results show that the sulfuric acid attacks the aliphatic structures in the coal first, forming aliphatic hydrogen sulfate and sulfonic acid groups. Oxidation or cyclization by the hot sulfuric acid increases the aromaticity of the product. At higher temperatures some of the sulfur-containing groups are replaced by phenolic and ketonic groups. Indications are that the sulfur groups formed during the reaction retard further oxidation of the coal residue.

Microfilm $2.75; Xerox $5.40. 108 pages.

EFFECTS OF PULSED FLOW IN FIXED ION-EXCHANGE BEDS

(Order No. Mic 60-5514)

Martin Warren, Ph.D.
Case Institute of Technology, 1960

A study was made of the performance of an ion-exchange process in which hydraulic pulses, at a frequency of 340 per minute, were applied to the fluid passing through a fixed bed. The pulse increased the fluid turbulence which decreased the apparent thickness of the fluid film that surrounded the resin particles. This effect increased the concentration gradient across the fluid film and increased the apparent resin capacity. However, when the retention time within the bed was sufficiently long, the pulse caused a considerable amount of axial mixing which decreased the apparent resin capacity. For short beds, the height of the exchange zone was a linear function of the bed depth. The zone lengthened as the amount of axial mixing and the flow rate were increased. The effects of flow rate, pulse, and concentration on the resin capacity and the zone height were explained by the concentration gradients in the fluid and by the driving forces which controlled the exchange process. The process of pulsing was most beneficial for short beds in which the rate controlling step was film diffusion.

Microfilm $2.75; Xerox $3.00. 42 pages.

THE RADIATION CHEMISTRY OF COAL IN VARIOUS ATMOSPHERES

(Order No. Mic 61-2407)

Allan Weinstein, Ph.D.
The Pennsylvania State University, 1961

The objectives of this work were to study the radiation chemistry of bituminous coals and the reactions of the coals with various gases in the presence of radiation. Special attention was given to radiative oxidation, which had been reported to produce beneficial Gieseler fluidity changes with several coals.

Samples were prepared by introducing measured quantities of oxygen, ammonia, nitrogen or air into containers holding 35-gm. portions of evacuated -40 mesh coal. The containers were sealed with these gases (or in vacuo), and were then irradiated in a nuclear reactor. Cadmium shielding minimized slow neutron flux into the samples. The energy absorbed by the samples corresponded to about 3.2×10^8 rads of gamma radiation and 0.3×10^8 rads of fast neutrons. A kinetic study of the non-radiative oxidation of the coals was also performed for the purpose of comparison. The radiation chemistry of pure ammonia was studied for the same reason.

The amount of gas remaining in each sample container following treatment was measured, and the composition of the gas was determined by gas chromatography. The Gieseler fluidity of the coal sample was then determined. The E. P. R. spectra of the original coals and of those irradiated in ammonia were also determined in order to detect any change in the free-radical concentrations of the coals.

Only hydrogen, methane and possibly traces of ethane were formed by radiolysis of the coals. This was demonstrated by the large difference in the yields of these gases obtained from evacuated samples under radiative and non-radiative conditions.

The yields were independent of the presence of oxygen, so that oxidative side reactions were negligible during radiolysis. The hydrogen yields were independent of the water contents of the coals. The constant methane to hydrogen ratio for each coal suggested that the amounts of these gases produced depended on the hydrogen atom concentration existing inside the coal during radiolysis.

The yields of carbon oxides per unit of oxygen adsorbed from the samples irradiated in oxygen were little different from the yields with the samples oxidized in the absence of radiation. The rate of desorption of adsorbed oxygen was also little affected by radiation. Fluidity changes previously reported could not be duplicated under any of the conditions employed, and it was concluded that they were due to experimental difficulties with the Gieseler apparatus.

Radiation increased the rate of oxidation of at least 1 of the 4 coals studied under oxidizing conditions. This was probably due to the formation of oxygen atoms or ozone during irradiation. The rate of the non-radiative oxidation of another of the coals could be described by means of the Elovich equation, even though the coal had been oxidized previously during grinding. This extended the conditions under which the equation has been observed to have been obeyed. It also suggested that this equation might have more widespread utility in describing coal oxidation kinetics than has heretofore been suspected.

It was observed that the yields of carbon oxides depended linearly on the amount of oxygen adsorbed. A mechanism of formation of the oxides was postulated. This mechanism involved the formation of an energetic intermediate surface complex, and suggested the presence of a small number of weakly bonded carbon atoms as a structural feature of coal.

The gases evolved from coals irradiated in ammonia contained much more hydrogen than those from vacuum-irradiated samples. This extra hydrogen was not due merely to the decomposition of ammonia, since there was no corresponding increase in the amount of nitrogen produced. It was concluded that the ammonia had reacted with the coals. A mechanism involving the attack of amine radicals on the coals was postulated.

The reaction of nitrogen with the coals, which was first observed with air-irradiated samples, was confirmed by irradiating several samples in pure nitrogen. Not enough data were obtained, however, to permit any further conclusions or mechanistic interpretations to be made.

Microfilm $2.75; Xerox $7.40. 159 pages.

A NEW CORRELATION FOR DIRECT CONTACT HEAT TRANSFER COEFFICIENTS IN BAFFLE AND PERFORATED PLATE TOWERS

(Order No. Mic 61-2132)

Donald Allen Winkler, Ph.D.
Louisiana State University, 1961

Supervisor: Professor Jesse Coates

Direct contacting of liquid and gas for the purpose of heat transfer is finding increased application throughout industry. Design procedures for baffle plate, disk-and-donut, and perforated plate equipment are quite well established. Design data for such applications, however, notably heat transfer coefficients, are lacking. It was the purpose of this research to establish the relationships between these coefficients and the pertinent variables of the system and the equipment.

To eliminate the problem of scaling up results, a "section" of a full-size tower was employed in the investigations. It consisted of a 6" x 18" steel box, 10 feet tall, fitted with a plexiglass cover to allow viewing of the contacting process. It could be fitted with two plates, the lower being movable, to represent a section of a baffle plate tower, or with a perforated plate, to represent a section of a perforated plate tower.

Models of the contacting process have been proposed and data analysis methods derived from them. One such model was employed in this research to formulate a new method of data analysis for the situation of direct contact heat transfer with negligible mass transfer.

A group of 75 runs was made with the apparatus set up as a baffle plate tower. Analysis of the results showed that a correlation existed between the heat transfer factor, j_H, and an expression including the Reynolds number of the gas stream (based on the superficial liquid curtain area), the ratio of liquid flow rate to gas flow rate, and the Ohnesorge group, as follows:

$$j_H = (hD/k)_G (c\mu/k)_G^{-.33}$$

$$= 0.048(DG/\mu)_G^{1.4}(L/V)^{.33}(\mu/\sqrt{\rho g_c D\sigma})_L^{.5}$$

It was thereby shown that the physical properties of the liquid stream are important, and should be included in direct contact heat transfer correlations. These properties and the ratio of liquid flow rate to gas flow rate strongly influence the degree of dispersion of the liquid phase, and consequently, the heat transfer coefficient.

A group of 31 runs was made with the apparatus set up to represent a perforated plate tower. For the perforated plate results, a similar correlation was found to exist between j_H and the gas stream Reynolds number, based on the flow area through the perforations, as follows:

$$j_H = (hD/k)_G (c\mu/k)_G^{-.33} = \exp\left[2.8(10^{-6})(DG/\mu)_G\right]$$

This correlation was not improved by the introduction of additional terms describing the liquid physical properties or the ratio of liquid flow rate to gas flow rate. This is not interpreted to mean that these variables have no effect, but that their influences are hidden by the influences of the perforations, which accomplish dispersion of the liquid stream directly.

The Wilson-Orrok method of graphical analysis of heat transfer data was employed to determine the influence of the liquid-phase resistance to heat transfer; this influence was found to be negligible.

Microfilm $2.75; Xerox $4.80. 92 pages.

EFFECTS OF PARTICLE SIZE DISTRIBUTION ON SALTATION VELOCITY AND BIN FLOW

(Order No. Mic 61-1271)

Frederick A. Zenz, D.Ch.E.
Polytechnic Institute of Brooklyn, 1961

Adviser: Donald F. Othmer

This investigation was undertaken principally to attempt to resolve quantitative discrepancies between saltation velocities (defined as the minimum fluid velocity required to convey a given mass rate of particle-form solids in a horizontal pipe without "salting" or settling out of a layer of the solids on the bottom of the pipe) calculated from published correlations for transport of uniform size particles, and certain observations of saltation rates in gas-solids transport systems of industrial interest. It was also anticipated that a fundamental quantitative correlation of saltation might afford the basis for resolving discrepancies in pressure drop measurements, and therefore such data were gathered as well, again particularly for a system showing poor agreement with earlier correlations.

The principal contributions resulting from this work may be summarized as follows:

1) The new concept of a single-particle horizontal flow (as opposed to vertical or free fall) drag coefficient has been proposed in conjunction with supporting experimental data covering a range of particle Reynolds numbers from 1.62 to 2965. The data were obtained with particles ranging from 0.0004" to 0.25" in diameter and having densities of 10 to 165 lbs/cu.ft. The experiments were carried out with air and water media in $1\frac{1}{4}$" and $2\frac{1}{2}$" I.D. lucite tubes.

2) The single particle horizontal flow drag coefficient can be approximated analytically by the relation $\sqrt{C_D} = 1-(1/Re_p)$ for the case of spherical particles in gaseous carrier medium. This relationship applies fairly well to liquid media also if the left hand side is written $\sqrt{10\ C_D}$. The data are best represented graphically as shown in the text in Figures 12 and 14. Of greatest significance is the fact that the curves exhibit a minimum and deviate markedly from the vertical free fall drag curve as particle Reynolds number becomes less than 50. This indicates that small particles are much more difficult to convey horizontally than vertically and also more difficult to convey horizontally than larger particles.

3) A new empirical saltation velocity correlation has been proposed which correlates all published gaseous media data as well as the data obtained in this work. This correlation is shown in Figures 19 and 20 and may be represented analytically by the relation

$$\frac{W}{\rho_p} = 0.7\, S_\Delta^{1.5}(V_s - V_{s_0})/V_{s_0}$$

The correlated data include particle diameters from 0.0004" to 0.25", particle densities from 10 to 165 lbs/cu.ft., and distributions ranging from uniform size to about 18 fold between largest and smallest. This correlation is of particular importance since it applies to materials of mixed particle size as well as uniform size particles. The term S_Δ represents the slope of a line drawn between the points representing the extremes of particle size in a given mixture when plotted on the single particle horizontal flow drag coefficient curve. This term therefore characterizes the material grind and its relative transportability and with the accumulation of more experience in this method of correlation should prove to be a fundamental descriptive characteristic of a mixture of particles as important as particle diameter is for uniform sizes.

4) A new modification in the method of calculating pressure drop in horizontal conveying has been proposed which permits far wider application of the method. This modification, based on use of the horizontal flow drag coefficient as opposed to the vertical fall drag coefficient, permits extension of the method to small particles and to mixtures of particle sizes whereas previously it had shown agreement only with data obtained in the transport of relatively large uniform size particles.

5) The composite of above developments has permitted greater definition of the horizontal transport phase diagram both qualitatively and quantitatively. This emphasizes in particular the fact that most horizontal conveying lines carrying fine powders must now be operating in slug flow and that true dense phase or mass flow is the direction for future development work.

The effect of particle size distribution on saltation velocities was investigated by transporting pneumatically three size ranges of sand (all having about the same geometric weight mean diameter) and three size ranges of a fluid cracking catalyst, in a $1\frac{1}{4}$" I.D. lucite pipe at varying air and solids rates. Saltation velocities for single

particles were measured for 15 different solid particles of varying size, shape and density.

Since specifically sized materials had to be prepared in these investigations, measurements were also made of their angles of repose and internal friction as they flowed from a transparent lucite bin section.

The most significant results of this work lie in the correlation of single particle saltation rates (the equivalent horizontal flow drag coefficient) and the concept of S_Δ. These not only provide the bases for calculating conveying rates and pressure loss but bring into quantitative definition the observations that fine powders are far more difficult to convey than large particles.

Microfilm $2.75; Xerox $7.40. 158 pages.

ENGINEERING, CIVIL

STRESSES IN SOIL MASSES UNDER VARIOUS BOUNDARY CONDITIONS

(Order No. Mic 61-1318)

William Daniel Finn, Ph.D.
University of Washington, 1960

Chairman: R. G. Hennes

The stresses in soil masses confined by boundaries that undergo small displacements are determined. Both translational and rotational displacements are considered.

It is assumed that, for such small displacements, the theory of elasticity can be used. Under this assumption, the stresses in a soil mass with a yielding base are determined for a frictionless base, a base with adhesion and a rough base.

Using the yielding base as the fundamental case and making suitable corrections for altered boundary conditions, the pressures against translating and rotating retaining walls are determined. Again the cases of no friction, adhesion and friction are considered, and also the influence of surcharge.

The influence of the configuration of the soil mass in the stresses is discussed by examining the stress field for slopes and dams.

The stress and pressure distributions predicted by the theory are checked against published experimental data and exhibit a high degree of correlation. It appears that the theory of elasticity may be applied, with confidence, to the determination of soil pressure distributions against retaining structures when the displacements of those structures are small.

Microfilm $2.75; Xerox $6.40. 134 pages.

A STUDY OF STRUCTURAL PROPORTIONING UTILIZING THE CONCEPT OF A LIMITING PROBABILITY OF FAILURE OF THE TOTAL STRUCTURE

(Order No. Mic 61-2483)

Gerald Eugene Ingram, Ph.D.
Purdue University, 1961

Major Professor: Marion B. Scott

This thesis is concerned with the development of a procedure by which a structure can be proportioned so that the probability of failure of the total structure does not exceed some predetermined value and, simultaneously, the total weight of the structure is a minimum. This study is confined to the cases of a structure formed by a group of members that are axially loaded only, a structure formed by a group of members that are loaded in flexure only, and a structure formed by a group of members that are subjected to both axial and flexural loads. The statistical quantities, or probability distributions, necessary in the solution of such problems, are discussed but the procedure is not limited to any particular type of distribution.

The approaches used are essentially the same for all three cases and each consists, basically, of four parts: (1) derivation of the expression for the probability of failure of an individual member of the structure, (2) derivation of the expression for the probability of failure of the total structure, (3) derivation of the expression describing the conditions under which the minimum weight structure is achieved, and (4) derivation of a procedure, to be used on a high-speed computer, for the simultaneous solution of (2) and (3) above.

The derivation of the expression for the probability of failure of an individual member consists of combining the probability distribution functions of the quantities that describe the strength properties of the member. For the case of a member that is axially loaded only, the expression is a triple integral involving axial load, cross sectional area of member, and yield strength of the material. For the case of a member that is loaded in flexure only, the expression is a triple integral involving moment, section modulus of member, and yield strength of the material. For the case of a member that is subjected to a combination of axial and flexural loads, the expression is a five-fold integral involving axial load, cross sectional area of member, moment, section modulus of member, and yield strength of the material.

The derivation of the expression for the probability of failure of the total structure consists of combining the probability of failure functions of all the individual members of the structure. The expression for the probability of failure of the total structure is merely the sum of the probabilities of failure of the individual members, minus some higher order terms that can be neglected due to their extremely small values in all practical cases.

The derivation of the expression describing the conditions under which the minimum weight structure is achieved consists of writing the weight function for the structure and then minimizing this function with respect to the variable quantities involved in the probability of failure functions of the members. It is assumed that the distribution describing the loading on the structure and the distribution describing the strength of the material in

the structure are known functions. Therefore, in the case of the structure formed by a group of members that are axially loaded only, the variable quantities are the cross sectional areas of the members. In the case of the structure formed by a group of members that are loaded in flexure only, the variable quantities are the section moduli of the members. In the case of the structure formed by a group of members that are subjected to both axial and flexural loads, the variable quantities are the cross sectional areas and the section moduli of the members.

The procedure, on a high-speed computer, of arriving at a solution to the problem described above, involves a numerical computation of the three-fold, or five-fold, integrals and then a numerical approximation of the curves describing the variation in probability of failure of the members. The expressions of Parts (2) and (3), given in the second paragraph, can then be solved, simultaneously, by a numerical procedure.

A numerical example was worked for the case of a structure formed by a group of members that are axially loaded only. The results indicate that the procedure is feasible. Microfilm $2.75; Xerox $5.40. 107 pages.

THE STATIC AND DYNAMIC PHENOMENOLOGICAL MACRORHEOLOGY OF COHESIVE SOILS

(Order No. Mic 61-1899)

Robert Louis Kondner, D.Eng.
The Johns Hopkins University, 1961

The phenomenological macrorheology of a cohesive soil is described with viscoelastic parameters determined by stress relaxation, creep, and dynamic testing methods. The creep and stress relaxation studies were conducted in uniaxial compression and the dynamic studies were conducted in vibratory uniaxial compression and vibratory simple shear. The dynamic variables considered include the frequency of vibration, ratio of vibratory stress amplitude to static stress, amplitude of strain, specimen size, damping, and strain rate effects. Particular attention has been given to the actual linear and non-linear aspects of the response. The use of rheologic models as an aid to the understanding of the material response is illustrated with the use of spring-dashpot models. The methods of dimensional analysis in conjunction with small-scale model tests are used as a general research tool to study the rheologic response of soil-solid systems. The potential value of such non-dimensional techniques in soil mechanics investigations is illustrated by studies of penetrometer methods in clay, the bearing capacity of rigid footings on clay, and the development of a working hypothesis relating the various parameters influencing the efficiency of soil cutting and penetration by a combined static-vibratory loading. Microfilm $2.75; Xerox $8.40. 185 pages.

INELASTIC LATERAL INSTABILITY OF BEAMS AND THEIR BRACING REQUIREMENTS

(Order No. Mic 60-6513)

George Chao-Chi Lee, Ph.D.
Lehigh University, 1960

This dissertation presents the results of a theoretical and experimental study of the inelastic load-deformation behavior of structural steel beams subjected to uniform moment.

An upper bound solution for the critical buckling length of simply supported wide-flange beams subjected to full plastic moment ($L_{cr} = 40r_{yy}$) is obtained. The theoretical solutions are substantiated by experiments on simply supported beams with idealized supports.

From the results of these experiments it is concluded that a beam can develop satisfactory plastic hinge rotations in the post-buckling range provided the slenderness ratio is not more than 40. These tests show also, that the usefulness of the plastic strength of such beams is controlled by the local instability of the compression flange, and that the rotation capacity does not depend upon the occurrence of lateral buckling.

Further experiments on beams supported by bracing members of practical proportions are performed. These beam-purlin tests indicate that the flexible bracing members are fully as adequate as rigid lateral braces to insure the development of a plastic hinge provided that their lateral stiffness is above a certain critical value.

A theory considering the interaction of deformation variables is developed for obtaining the post-buckling behavior of beams governed by lateral-torsional instability. The theory also accounts for initial imperfection of loading and member geometry (biaxial bending).

Microfilm $3.15; Xerox $11.05. 244 pages.

STABILITY OF ELASTIC AND PARTIALLY PLASTIC FRAMES

(Order No. Mic 60-6514)

Le-Wu Lu, Ph.D.
Lehigh University, 1960

The objective of this dissertation is to determine the buckling strength of pinned-base portal frames in the elastic and partially plastic range. The frames are acted upon by a uniform load on the beam and two equal concentrated loads on the columns. It is assumed that failure occurs by sidesway instability in the plane of the applied loads.

It is first pointed out that frame design may be based on one of the following three types of limiting strength: the plastic strength, the inelastic buckling strength and the elastic buckling strength. The importance of developing methods for predicting these strengths is indicated.

An exact solution for elastic buckling of portal frames is obtained. Using this solution, the effect of primary bending moment present in each member at the instant of buckling is clarified. The solution is verified by buckling tests on model steel frames.

A precise method of elastic-plastic analysis for rigid

frames is developed. It takes into consideration such effects as axial thrust, yielding, deformations, and residual stresses. The method may be used to determine the stiffness of columns at any stage of loading and also the strength of frames which are prevented from sidesway movement.

Utilizing the results from the elastic-plastic analysis, the problem of sidesway buckling of partially yielded frames is solved. The method of solution is based on a modified moment distribution procedure in which all the necessary constants are modified for the combined effects of axial force and inelastic action. The method is illustrated in connection with the development of a frame buckling curve.

A discussion on the application of the solutions obtained to the design of building frames is included. A method whereby design charts for elastic and inelastic buckling may be derived is also presented.

Microfilm $2.75; Xerox $8.20. 178 pages.

EVALUATION OF MAJOR URBAN INTERSECTIONS

(Order No. Mic 61-2504)

William Walter Schenler, Ph.D.
Purdue University, 1961

Major Professor: Harold L. Michael

A rating system is proposed for major urban intersections, which are in reality the source of trouble and delay in urban street networks. The general principles developed apply to all intersections; in addition specific rating values are developed for certain at-grade intersections which are controlled by fixed-time signals. The Intersection Rating proposed is a "sufficiency rating" and is stated as a percentage of a "fully-sufficient" intersection. Factors influencing the ability of the intersection to serve traffic are divided into two general categories which are rated independently and combined to establish the Intersection Rating.

The Physical Rating of the intersection includes ratings for factors which are concerned with the structural and geometric conditions existing at the intersection. Elements rated include surface condition, surface thickness, ridability, skid resistance, geometrics, curb radius for right turns, visual restriction and lighting, among others. These factors rate the intersection as a physical unit, without regard for the amount or characteristics of traffic or control involved, except that general traffic volume levels do influence certain of the ratings such as surface thickness and lighting.

The Traffic Rating is a device for evaluating user satisfaction with the service rendered by the intersection under existing volume and control conditions. Average delay per vehicle was selected as the criterion, and a rating scale was established. For the restricted case where uniform arrival and fixed-time signals exist or can be assumed, theoretical volume-delay relations were established for appropriate cycle lengths and cycle divisions. These relations are presented in graphical form. From these volume-delay relations, Traffic Rating graphs were prepared. These graphs also cover the cycle lengths and divisions considered appropriate. The derivation of the rating graphs is explained.

In order to determine whether or not there was reasonable agreement between the theory and actual traffic flow, field investigation was undertaken. The procedures used and results obtained are discussed in connection with the Traffic Rating. It was concluded that there was reasonably good agreement between the theory and actual traffic performance.

Since the Traffic Rating is of necessity based on the individual approaches, and the Physical Rating represents the intersection as a unit, it was necessary to get to a common basis. A composite Traffic Rating for the intersection as a unit was calculated; then, with both ratings on an intersection basis, they are suitable for combining to get the Intersection Rating. Certain boundary conditions were considered appropriate and desirable; these are discussed in some detail. A suitable combining relation was developed, and a table is presented for convenient solution of this equation.

Following the completion of the rating system it was again necessary to investigate in the field, to see whether or not results of the proposed rating agreed with ratings based on informed opinion. The comparison of opinion ratings for selected intersections (made before application of the formal rating system) and corresponding Intersection Ratings is shown and the validation study discussed.

Microfilm $2.75; Xerox $8.20. 178 pages.

A STUDY OF CHERT AND SHALE GRAVEL IN CONCRETE

(Order No. Mic 61-2505)

Robert Lee Schuster, Ph.D.
Purdue University, 1961

Major Professor: John F. McLaughlin

Certain chert and shale gravels have long been recognized as harmful when included in portland-cement concrete exposed to freezing and thawing. Many organizations have specifications limiting percentages of these materials in concrete aggregates, but few of these specifications distinguish between types of chert and shale from different geographical areas nor do they always take into account the basic physical properties of these materials.

In this study, pore characteristics, mineralogy, texture, and structure were determined for cherts and shales from nine Indiana glacial gravel deposits by means of microscopic petrography, x-ray diffraction, and the common specific gravity and absorption techniques. Blends of two, four, six and ten per cent of chert or shale from each source were made with a standard durable crushed limestone coarse aggregate, and these blends were used in 3- by 4- by 16-inch air-entrained concrete beams subjected to up to 300 cycles of freezing-and-thawing. A measure of the amount of deep-seated deterioration of the beams was provided by durability factors calculated from the results of non-destructive sonic testing of the beams at intervals during freeze-thaw testing. Severity of surface deterioration was also evaluated. The influence

of the basic properties of the chert and shale gravels on the results of the freeze-thaw tests was then determined. On the basis of the results of these tests, study was made of the existing specifications on cherts and shales to determine whether the specifications realistically categorize these materials.

Despite significant differences in their mineralogies, no difference was noted in the freeze-thaw durabilities of the various chert samples. For all the cherts, significant deep-seated and surface deterioration occurred only in beams containing six to ten per cent of material with a bulk specific gravity (saturated surface-dry basis) of less than 2.45.

Although the basic properties of the shales varied even more widely than those of the cherts, none of the shales caused deep-seated failure of the concrete. However, the most porous shales caused "popout" damage which was especially severe at the six to ten per cent levels.

Microfilm $2.85; Xerox $9.90. 220 pages.

ENGINEERING, ELECTRICAL

THE EIGENVALUES FOR CERTAIN CYLINDRICAL STRUCTURES

(Order No. Mic 61-2461)

Donald Martin Bolle, Ph.D.
Purdue University, 1961

Major Professor: William H. Hayt, Jr.

This work is an investigation of the eigenvalues of certain systems that have circular symmetry and it uses Hahn's general method of attack but using Fourier-Dini expansion for the field components. Associated problems that are considered are the delay line or low pass filter, the matched coaxial support, and the "thick" free space dipole.

Lommel integrals are applied to yield the coefficients of the field expansions for cavities that may be subdivided into orthogonal subspaces. In order to test the utility and accuracy of this method the resonant frequencies for a certain cylindrical structure are calculated. It is found that the resonant frequencies could be predicted with an accuracy of greater than one percent with a minimum of effort. A method of computation is developed and the limits of the accuracy are discussed, together with tests to determine the minimum number of significant figures to be carried through in the calculation in order that meaningful results may be obtained for the dominant as well as the higher order modes.

It is shown that the series to be considered converge rapidly enough so that new functions need not be constructed to obtain a more rapid convergence of these series. This is particularly true with the increased availability of digital computers.

The results obtained are compared with Slater's perturbation theory and with measured results. Good agreement between measured and calculated results are obtained. This theoretical method also allows the evaluation of the geometric proportionality factor that occurs in perturbation theory.

The last part of this work is the application of Fourier and Fourier-Dini series to the surface current of a thick free space dipole. The integrals that occur in the evaluation of the vector magnetic potential and subsequently the radiation fields are considered. It is shown that although these integrals are complex they may be evaluated without introducing prohibitive numerical work.

Microfilm $2.75; Xerox $7.20. 152 pages.

A POST ACCELERATION KLYSTRON LINEAR PARTICLE ACCELERATOR

(Order No. Mic 61-2232)

Marvin F. Eisenberg, Ph.D.
The University of Florida, 1961

A post acceleration type of klystron has been combined with an accelerating cavity to form a linear particle accelerator. This system has been named the "Accelatron" and should be capable of accelerating charged particles to energies of 10^5 to 10^6 electron volts.

The accelatron utilizes the transformation properties of a resonant cavity and a post acceleration klystron to obtain a high accelerating a-c voltage, which is contained completely within the cavity, from a much lower external d-c voltage.

The post acceleration klystron, which may operate as either an amplifier or an oscillator, transforms the d-c voltage into an a-c voltage of approximately the same magnitude which is then transformed to a much higher voltage by the cavity. The post acceleration type of klystron was chosen for the accelatron since it appeared to have better bunching characteristics and therefore higher efficiency than the standard klystron, although it requires a greater amount of r-f driving power when operating as an amplifier. In addition, for pulsed operation the post acceleration klystron requires a much smaller pulse power supply than that required for the standard klystron.

A theoretical analysis of the post acceleration klystron is performed including the determination of optimum bunching conditions and the derivation of design equations. The results of this analysis, using ballistic theory, predict a maximum electronic conversion efficiency for the post acceleration klystron of approximately 70%.

The design, construction, and testing of an accelatron model is described. In addition, the design of a one million electron-volt accelatron is discussed.

The theoretical and experimental results indicate that a high energy accelatron may be feasible and that further research in this direction is justified.

Microfilm $2.75; Xerox $5.20. 104 pages.

ELECTROMAGNETIC RADIATION DUE TO VIBRATING SYSTEMS OF CHARGES AND CURRENTS

(Order No. Mic 61-2469)

Charles Marcus Evans, Ph.D.
Purdue University, 1961

Major Professor: William H. Hayt, Jr.

In this work a method of attack analogous to the Eulerian viewpoint in fluid mechanics is developed for problems involving the electromagnetic fields produced by moving charges and currents. To demonstrate the method, a few elementary examples involving simple harmonic motion are treated.

It is shown that such moving systems radiate power and, further, that when the motion is periodic, the radiation occurs at all harmonics of the vibration frequency.

Finally the problem of symmetrically placed point charges in uniform circular motion is treated. Here it is shown that the radiation loss due to centripetal acceleration may be minimized by increasing the number of these charges. Also it is shown that this is an effective scheme of producing frequency multiplication.

Microfilm $2.75; Xerox $4.00. 74 pages.

THE USE OF MAGNETOSTRICTION TO ACHIEVE FAST ADJUSTMENT OF ROLL SEPARATION IN MULTI-STAND ROLLING MILLS

(Order No. Mic 61-2867)

Bertil Svante Mikael Granborg, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Harold A. Peterson

Like many other engineering fields the making and shaping of steel have developed through the years as an art. This is especially true concerning strip steel rolling, which in principle amounts to flattening of heavy steel pieces to thin sheets by means of two rotating rolls, and amazingly good results have been achieved through pure skill. However the demand for better quality and increased production speed necessitated automation and therefore scientific investigations of the problem have been made but these seem inadequate because of modern requirements.

In the present thesis an investigation of the actual process of rolling has been undertaken where the chief goal is to produce steel strips with tolerances of the order of 10^{-3} inch under thousands of tons of roll pressure and with strip speeds of at least 6000 feet/min.

With this fundamental background a critical study has been performed of the abilities of the indicating and acting equipment presently in use by industry. The result showed insufficiencies in particular with respect to speed in performance and accuracy.

In order to gain most in improvements the investigation was concentrated upon the apparently weakest detail, which emerges to be the roll adjuster by means of motor screw down. Because of the fundamental conditions under which the adjuster has to work another physical phenomenon appears necessary to achieve the desired result. Magnetostriction seems to fit these conditions and a comparison between the old and the new method showed the following as an example for a large mill. The old method gives an effective strip gage change on the order of 0.002 inch/sec. and the new method ought to give at least 0.1 inch/sec. or with a strip speed of 100 feet/sec. and an off gage correction of 10×10^{-3} inch, 500 feet would be lost with the old method but less than 10 feet with the new one. Note that it ought to be possible to decrease the latter figure substantially by using sufficient amplification in the feedback loop. Roll pressures are substantially the same in either case. In addition, there should be practically no lower limit with respect to accuracy. The above computations were based on the cobalt-ferrite materials, which have the extremely high magnetostriction of 800×10^{-6} inch/inch.

Since the full scale device seemed promising the next step was to show that the magnetostrictive method could function in model scale. For this purpose three materials, nickel, 50-50% cobalt-iron and 13-87% aluminum-iron, were experimentally investigated of which the cobalt-iron alloy specimens showed a saturation magnetostriction of about 78×10^{-6} inch/inch and a time response of less than 200 ms. The latter samples were then used in conjunction with mechanical amplification in a model scale mill where an effective strip gage change of about 10^{-3} inch could be measured. The response time was of about the same magnitude as that found previously in making laboratory tests on samples of the magnetostrictive material used.

Microfilm $2.75; Xerox $7.60. 161 pages.

NUMERICAL METHODS OF APPROXIMATION WITH APPLICATION TO ELECTRICAL NETWORK DESIGN

(Order No. Mic 61-2486)

Richard Reid Kenyon, Ph.D.
Purdue University, 1961

Major Professor: Robert P. Siskind

The problem considered is the following: A set of non-negative weights w_i together with a function g specified only by the numerical values $g(t_i)$ and t_i for $i = 0, \ldots, m-1$ is given. An approximating function f containing n parameters $p_0, \ldots, p_{n-1}$ is to be determined such that f is a best approximation either: 1) in the weighted least squares sense, i.e., such that

$$\sum_{i=0}^{m-1} w_i^2 \, [f(t_i) - g(t_i)]^2$$

is minimized; or 2) in the weighted minimax sense, i.e., such that

$$\max_i \left| w_i \, [f(t_i) - g(t_i)] \right|$$

is minimized. A number of numerical methods are discussed for computing values for the unknown parameters.

A new method is given for approximation by a rational function which follows:

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

$$f(t) = \frac{\sum_{j=0}^{p} a_j t^j}{\sum_{j=0}^{q} b_j t^j}$$

using the weighted minimax criterion. Each step requires finding the best minimax approximating rational function on a subset of p+q+2 points. This portion of the problem is solved as an eigenvalue-eigenvector problem $Ax = \lambda Bx$ where A and B are matrices of order p+q+2. Only the eigenvalue λ of smallest magnitude and an associated eigenvector x are determined. The components of the eigenvector are the numerator and denominator coefficients, while the eigenvalue is the maximum error of approximation.

Microfilm $2.75; Xerox $8.20. 180 pages.

ON "BANG-BANG" ADAPTIVE CONTROL SYSTEMS

(Order No. Mic 60-4308)

Richard E. Kopp, D.E.E.
Polytechnic Institute of Brooklyn, 1961

Adviser: John Truxal

The purpose of this dissertation is to investigate techniques for applying the "Adaptive Control" concept of design to a "Bang-Bang" control system. This design results in a system which will adapt itself to the environment in which it operates. In addition the actuator will have only two signal levels; that is, a full positive signal, or a full negative signal. From an adaptive point of view, an investigation of this type of system is motivated by the system's inherent advantages. One of the primary advantages is that the full output of the actuator is being used at all times, a requirement to have the equilibrium state reached in a minimum time for many of the normally encountered control systems. A second equally important advantage is that the input signal to the controlled process is always well defined. This latter advantage is of considerable aid in the determination of the process characteristics.

To characterize the process a truncated power series is used to represent the process impulse response. This polynomial is a two term least square fit to the true impulse response evaluated over a finite time interval. It is shown that the two coefficients of the series can be determined from the step response of the process. A transfer function of a physically realizable network is derived such that these coefficients can be obtained by sampling the output of the network at the end of the time interval over which the least square fit is made.

Extensive use is made of phase plane analysis to determine the optimum switching criterion by classical methods for second-order integral processes with damping and without damping. It is then shown that both the gain and time constant of the processes, which are needed to generate the switching boundary, can be obtained from the two coefficients of the polynomial. An approximate switching boundary which is more easily instrumented is developed and compared with the optimum switching boundary. When these classical methods are extended to the design of higher order systems the optimum switching boundaries in phase space become complicated and the instrumentation necessary to generate them becomes too involved to be of practical use.

An approach, different from classical methods, is then developed which is applicable for higher order systems with arbitrary inputs. It utilizes directly the coefficients of the impulse response power series for determining the switching boundaries. The future error and error rate are continuously approximated with two different Taylor series for the actuator in its present as well as its only other possible position. The logic of a simple switching computer is evolved to determine when the actuator should be switched to make the error and error rate go to zero simultaneously in the shortest period of time.

Several methods for evaluating the relative stability of second and higher order "Bang-Bang" control systems, that is the amplitude and frequency of the resulting limit cycle, are discussed. The effect of time delay and process measurement errors on the relative stability is analyzed. The amplitudes and frequency of the limit cycle is calculated for a second and third order system assuming errors in the impulse response coefficients proportional to the magnitude of the limit cycle as well as proportional to the rate at which the process parameters vary.

The justification for the approximations made in the theoretical development of the switching boundaries is supported by the use of an analog computer. Systems up to and including the fourth order were simulated with sinusoidal, step and ramp inputs and found to confirm the theory. Microfilm $2.75; Xerox $6.00. 125 pages.

OPTIMIZATION IN A MEAN-SQUARE-ERROR SENSE OF A TWO-DIMENSIONAL SAMPLED-DATA SYSTEM

(Order No. Mic 61-2868)

Charles Harold Murrish, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Thomas J. Higgins

The mean-square-error minimization of a sampled-data system with two correlated inputs and two non-interacting outputs is studied. The basic system configuration is established; a comparison is then made with a so-called desired system to establish the mean-square-error in terms of the power spectral-density functions of the inputs and the transfer functions of the two systems; and this mean-square-error is then minimized by the method of quadratic forms. Use of the general analysis in practice is illustrated by solution of a numerical example. Microfilm $2.75; Xerox $7.40. 156 pages.

REVERSIBLE AND SLOW SPEED IRREVERSIBLE MAGNETIZATION PROCESSES IN 50% NICKEL-IRON ALLOYS

(Order No. Mic 61-2494)

Lawrence Lyle Ogborn, Ph.D.
Purdue University, 1961

Major Professor: F. J. Friedlaender

A model is developed which can be used to describe the d-c magnetization characteristics of grain-oriented 50% nickel-iron in the saturation region. The model is based on the characteristics of semicylindrical domains of reverse magnetization at the surface of the material.

Small signal susceptibility is defined and analytic expressions are derived to predict the variation of this susceptibility as a function of a d-c biasing field and as a function of frequency. Experimental evidence is given to verify the theory. The results are used to develop an equivalent circuit which can be used in engineering problems involving this material. During a high speed flux reversal, small a-c signals were superimposed and the induced voltage was investigated. The value of small signal susceptibility was found to be smaller when the average domain wall velocity was zero.

Extremely slow speed flux reversals were studied. An analog computer was used to produce flux reversals during intervals as long as 10 minutes. Flux reversals producing constant rates of change of flux and reversals due to constant rate of change of applied mmf were developed. The resulting Barkhausen noise was studied. The mmf requirements were found to depend on the ratio of outside diameter to inside diameter of the core.

Microfilm $2.75; Xerox $5.40. 107 pages.

PARAMETER TRACKING AND ADAPTIVE CONTROL SYSTEMS

(Order No. Mic 61-2057)

Narindra Nath Puri, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. C. N. Weygandt

The latest development in the art of feedback technology is the study of the systems in which the environmental behaviour of the system is not predetermined, but rather becomes available as the process unfolds itself. The logical approach to the optimum design of such devices would be to incorporate in them the ability to "learn" about the environmental changes and thereby bring about necessary changes in its own characteristics or transfer function, in such a way as to keep the system optimized according to certain pre-defined criteria. Such a system has been defined as the adaptive control system. Here an attempt has been made to define and classify adaptive systems and a broad class of such systems called "process adaptive systems" has been investigated. Such systems involve changes in the parameter of the controlled element with time and the over-all "process adaptive system" is required to change the parameters of the controller in such a way as to counter-effect these changes thus keeping the system optimized.

Thus it may be inferred that the heart of the problem lies in determining the parameters of the system. Therefore two schemes are devised for instant by instant tracking the parameters and thereby the transfer function of the system. Both these schemes consist in perturbing the normal process with small amplitude perturbation signals (sinusoids in the present case). The first scheme seems to be more useful when a multi-order system consists of a number of elements with transfer function of the form $\frac{1}{s+a}$ connected in tandem. The second scheme is more general and is applicable to a system which can be represented by a multi-order differential equation. An important feature of the second scheme is its ability to track parameters when even the form of the transfer function (i.e. the order of the differential equation) is not known.

Next phase of the investigation is devoted to the treatment of the multivariable systems where the criteria of optimization is that of non-interaction. Mathematically speaking it means the dynamical diagonalization of the system matrix. The physical process is assumed to consist of time varying parameters. The parameters of the controlling elements are varied by the signals from the adaptive loops in such a way as to keep the over-all system matrix diagonalized. This again is accomplished by means of perturbing signals. The perturbing signals are injected to the system along with the normal input and these signals are uncorrelated to each other and to the normal system inputs. The action of adaptive loops depends upon the orthogonality relation. The output of the adaptive loop, let us say #1, is proportional to the average of the product of the output #1 and perturbing signal other than the perturbing signal #1. Thus under diagonalized condition the connections from the adaptive loops are zero. But if due to changes of the parameters of the physical plant the process transfer function matrix changes, the diagonalized condition is disturbed and adaptive loops come into action and adjust the parameters of the controlling elements. The scheme discussed is perfectly general and is applicable to the multi-order, multivariable control systems.

In the later part of the dissertation, a scheme is invented which tracks the parameters and thereby the transfer function of a multivariable system. Each element of the matrix of the above system may represent a rational function of s ($s = \frac{d}{dt}$). This scheme also works on the adaptive diagonalizations principle.

Microfilm $2.75; Xerox $8.40. 184 pages.

EXPERIMENTAL STUDY OF NUCLEAR REACTION INTERNAL NOISE AND TRANSFER FUNCTION USING RANDOM REACTIVITY VARIATIONS AND CORRELATION ANALYSIS

(Order No. Mic 61-1689)

Venkatesan Rajagopal, Ph.D.
Rensselaer Polytechnic Institute, 1961

Supervisor: Walter R. Beam

Analysis of internal fluctuations and response of a nuclear reactor have been carried out using analog correlation techniques, with a view to examining applications to the characterization of reactor dynamics, and to providing experience with such techniques.

The theoretical basis and the equipment for carrying out correlation studies are discussed. The basis for estimating the duration of data-taking and the computation method are described. The correlation system consists of a Frequency Modulation tape recorder with variable time delays from 0 up to 20 seconds, electronic multipliers and integrators. Random reactivity inputs have been realized by using an electromechanical system to convert a Gaussian random signal into linear motion of a small neutron absorber.

Measurements of the autocorrelation of internal fluctuations have been carried out at three power levels. The square root of the spectra of fluctuations is compared with the theoretical amplitude characteristics of the reactor transfer function. It is shown that with high detector efficiency the amplitude transfer function including the effect of delayed neutrons can be determined from the analysis of fluctuations.

Measurements of the autocorrelation function of a random reactivity input and the cross-correlation between this input and the "output" response (neutron density in the reactor) have been made and their spectra determined. The amplitude and phase transfer functions of the reactor have been determined for two input levels and compared with the theoretical curves. Applications and the usefulness of correlation methods in the analysis of reactor dynamics are discussed.

Microfilm $2.75; Xerox $6.20. 126 pages.

STABILITY ANALYSIS OF NONLINEAR CONTROL SYSTEMS BY THE SECOND METHOD OF LIAPUNOV

(Order No. Mic 61-2499)

Zenonas V. Rekasius, Ph.D.
Purdue University, 1961

Major Professor: John E. Gibson

This thesis investigates the stability of autonomous closed-loop control systems that contain a single nonlinear element. Both nonlinear gain elements and derivative-dependent nonlinearities are considered. An n-th order system is described by a set of n first order differential equations of the type

$$\frac{dx_i}{dt} = X_i(x_1, x_2, \ldots, x_n) \qquad i = 1,2, \ldots, n.$$

Liapunov's second (direct) method is used in the stability analysis of such systems. This method enables one to prove that a system is stable (or unstable) if a function

$$V = V(x_1, x_2, \ldots, x_n)$$

can be found which, together with its time derivative, satisfies the requirements of Liapunov's stability (or instability) theorems. At the present time, there are no generally applicable, straightforward procedures available for constructing these Liapunov's functions. Several Liapunov's functions, applicable to certain systems described by differential equations of the first canonic form,

$$\frac{dz_i}{dt} = \lambda_i z_i + f(x) \qquad i = 1,2, \ldots n$$

$$x = \sum_{i=1}^{n} \alpha_i z_i ,$$

have been reported in the literature. In this thesis it is shown that any autonomous closed-loop system containing a single nonlinear element can be described by the above canonic form of differential equations. Formulae for transforming the differential equations of such systems into the first canonic form are derived.

It is known that these Liapunov's functions are not applicable to many systems that are actually stable. That is, the simplified stability criteria in terms of the system parameters, which are derived from these Liapunov's functions, reject many systems which are actually stable.

The reasons why stable systems are sometimes rejected by these simplified stability criteria are investigated in this thesis. It is found that a closed-loop system with a single nonlinear element will always be rejected by these simplified stability criteria if the root-locus of the transfer function G(s), representing the linear portion of the system, is not confined to the left-half of the s-plane for all positive values of the loop gain.

A pole-shifting technique, proposed in this thesis, extends the applicability of the known simplified stability criteria to systems that are stable for sufficiently high values of the loop gain. The shifting of the poles of G(s) is accomplished by the change in variable y, defined by

$$y' = y - C_p x ,$$

where C_p is a real constant and the variables x and y represent the nonlinear element input and output, respectively.

Another similar technique of zero-shifting is developed to extend the applicability of simplified stability criteria to systems that are stable for sufficiently low values of loop gain. The shifting of the zeros of G(s) is accomplished by the change in variable x, defined as

$$x' = x - C_z y$$

where C_z is a positive constant.

A modification of the first canonic form of system differential equations was required to make the zero-shifting possible. New simplified stability criteria have been developed which incorporate the changes in the first canonic form of differential equations caused by the application of the zero-shifting technique.

A second canonic form of differential equations describing a closed-loop system has been reported in the literature. This second canonic form is also considered in this thesis, together with the associated Liapunov's

functions. A critical evaluation of this canonic form of differential equations reveals that it is applicable only to a very small number of systems that satisfy certain requirements.

Only systems which contain a single nonlinear gain element have been considered in the literature in connection with the canonic transformations and the associated Liapunov's functions. It is shown in this thesis how the Liapunov's functions used in the analysis of systems with nonlinear gain can be extended to certain systems that contain a single derivative-dependent nonlinearity.

The results of this thesis can be used to find sufficient conditions for stability for closed-loop systems containing a single nonlinear element. The results do not, however, enable one to find necessary conditions for stability for such systems.

Microfilm $2.75; Xerox $8.20. 180 pages.

A MICROWAVE TECHNIQUE FOR THE STUDY OF DEVIATIONS FROM OHM'S LAW IN HIGH RESISTIVITY SEMICONDUCTORS

(Order No. Mic 61-1662)

Kenneth Rose, Ph.D.
University of Illinois, 1961

The development of a microwave technique for the study of deviations from Ohm's law in high resistivity semiconductors is presented in this thesis. In this technique a high level microwave field is used to produce the deviations as well as measure them. A semiconductor sample is placed in a resonant cavity and the conductivity of the sample is inferred from measurements of transmission through the cavity. Preliminary measurements on samples of high resistivity silicon at temperatures down to the boiling point of liquid nitrogen are reported. The results of these measurements indicate that the technique in its present form is applicable to semiconductors with resistivities up to 600 ohm-cm.

Microfilm $2.75; Xerox $5.80. 117 pages.

DUAL-MODE FILTERING

(Order No. Mic 61-1251)

Leonard Glazer Shaw, Ph.D.
Stanford University, 1961

This report introduces the idea of a dual-mode (adaptive) filter which consists of two linear subfilters and an input-sensitive decision element which switches between them. Two classes of minimum-mean-square-error filtering problems are investigated. (1) SPECTRAL FILTERING concerns dual-mode extensions of Wiener filtering of stationary stochastic input processes. (2) POLYNOMIAL FILTERING concerns dual-mode extensions of a modified form of the Zadeh-Ragazzini model for filtering deterministic signals from random noise.

The idea of conditional mean square error is used to find the best dual-mode filter for a gaussian signal plus a kind of nongaussian noise. This noise is generated by random switching between two different gaussian noise processes. Several other forms of multimode spectral filtering are also discussed.

Dual-mode polynomial filtering is similarly investigated for a prototype problem and extensions thereof. The classical assumptions are modified so that the filters are constrained to be unbiased estimators over an ensemble of polynomials of a given order, rather than for each polynomial of the given order.

The subfilter design procedures used here are extensions of the techniques previously developed for designing similar optimum linear filters. The optimum switching problem bears significant resemblance to more standard problems in statistical detection theory. The novel arrangement of simultaneous optimization from both points of view results in transcendental equations which must be solved by trial and error. An efficient iterative procedure for searching out the solutions is presented.

In each case the best dual-mode filter is shown to be better than the best linear filter for the class of inputs under consideration. The input representations used here are logical extensions of previous filter-problem input models, and these models, and the present operations on them, reach into the realm of adaptive systems. These new points of view suggest many new directions for further developments in optimum-filter theory.

Microfilm $2.75; Xerox $6.00. 125 pages.

ENGINEERING, MECHANICAL

COMBINED FREE AND FORCED CONVECTION FROM ROTATING BODIES OF REVOLUTION

(Order No. Mic 61-2480)

Robert Gustave Hering, Ph.D.
Purdue University, 1961

Major Professor: R. J. Grosh

Combined free and forced laminar flows have been investigated for the case of a heated axisymmetric form rotating about its axis of revolution in a fluid otherwise at rest. Similarity methods were applied to the laminar three-dimensional boundary layer equations and the necessary conditions for the existence of similar solutions derived. Similar solutions were found to exist only for a cone with a linear wall temperature distribution and a circular cylinder with a $\frac{1}{x}$ wall temperature dependence.

In this flow situation, the primary flow parameter is the ratio of Grashof number to the square of Reynolds number. For small values of this ratio forced convection is of primary importance while for large values free convection dominates. This parameter is a constant for similar solutions. The transformed combined flow equations reduced in the limits of pure free and pure forced convection to those obtained previously.

Due to the nature of the transformed equations and boundary conditions, new computer techniques had to be

devised in order to integrate numerically the equations. The method is discussed and the computer flow diagram shown.

The transformed equations for the cone were integrated for pure free, pure forced, and the combined flow situations to obtain friction and heat transfer coefficients. The dimensionless heat transfer results in forced and free convection were respectively

$$N_{Nu} = 0.42852\, N_{Re}^{1/2}$$

$$N_{Nu} = 0.56699\, N_{Gr}^{1/4}$$

for $N_{Pr} = 0.70$. The combined flow results for Nusselt number exhibited a maximum deviation from the free or forced flow results of only 21 per cent. Criteria were given for cataloguing the flow regimes insofar as heat transfer and friction calculations are concerned.

The transformed equations for free convection from a non-rotating, isothermal cone were also integrated, for $N_{Pr} = 0.70$, resulting in a dimensionless heat transfer result given by

$$N_{Nu} = 0.45110\, N_{Gr}^{1/4}$$

Merk and Prins approximate result for this flow situation deviated from the above result by 1.5 per cent.

An experimental apparatus was designed and constructed to obtain verification of the theoretical heat transfer results for the cone. The apparatus consisted of a downward facing right circular cone of 60° included angle constrained to rotate about a vertical axis. Instrumented surface heaters enabled a linear temperature distribution to be set on the cone. Limited experimental data indicated the trends predicted by theory and verified the theoretical results within six per cent.

Microfilm $2.75; Xerox $8.40. 183 pages.

EXTENSIONS AND APPLICATIONS OF THE METHOD OF FINITE TRANSFORMS

(Order No. Mic 61-1873)

Stanley Kaplan, Ph.D.
University of Pittsburgh, 1961

The method of finite transforms for solving boundary value problems is applied to generalized heat conduction problems in an arbitrarily shaped three dimensional body. This leads to a class of transformations which are essentially three dimensional versions of the finite Sturm-Liouville transformations described by Churchill, Eringen, and others, and which possess analogous operational properties. The key step in the use of this class of transformations is the identification of those members of the class which will be useful for any given problem. Among those which are useful in a given case two kinds are distinguished. These are termed "resolving" and "nonresolving" according to whether the set of transformed equations is uncoupled or coupled. The mechanics of solution using these two kinds of transformation is developed and several illustrative and comparative examples given.

Application of the finite transform method to problems involving the bilaplacian operator is discussed, particularly in connection with problems arising from the deflection of thin plates. The transformations developed for the conduction problems are found to be useful for plate problems if the boundary conditions on the plate are of a restricted type. Additional transformations are identified which are useful under more general boundary conditions. A numerical example is given which uses a transformation of this latter type to find the deflection of an elastically restrained circular plate.

Microfilm $2.75; Xerox $6.20. 129 pages.

HEAT TRANSFER TO A MIST FLOW

(Order No. Mic 61-2496)

Jerald Dwain Parker, Ph.D.
Purdue University, 1961

Major Professor: Richard J. Grosh

An experimental and analytical study was made of the heat transfer characteristics of a mist flow of steam and water droplets flowing vertically upward in a round tube. A simplified analytical model, based on momentum, mass, and energy considerations, was developed which shows qualitatively that severe temperature fluctuations are characteristic of such flows under constant wall heat flux conditions.

The experimental investigation was made with steam at 30 psia flowing through an electrically heated one-inch ID copper tube, four feet in length. The quality was varied by the injection of water into the steam prior to its entry into the heated section. Total mass flow rates of 200, 300, and 400 lbs per hour were maintained for the tests. Heat fluxes were varied from 3,020 to 20,700 Btu/hr square feet, and inlet qualities were varied from 89 to 100 percent.

The experimental data showed that the analytical model gave a fairly accurate qualitative description of the tube wall temperature variation with length. The analysis of the data seemed to indicate that the assumptions of equilibrium between phases and constant values for the mass transfer coefficient for droplets were incorrect.

An electronic spray analyzer used in the investigation proved to be useful for the detection of droplets but was of little value in determining droplet spectrums.

Very high values of heat transfer coefficient were found for the annular-mist flow region that exists just upstream from the mist flow region. In the mist flow region two distinct types of heat transfer were noted, depending upon whether the spheroidal state existed for the droplets striking the heated tube wall. For wall temperatures below a certain value heat transfer coefficients 3 to 6 times those for dry steam were noted. For wall temperatures above this critical value the heat transfer coefficients were almost identical to those for dry steam, even with considerable moisture present in the mist.

Microfilm $3.25; Xerox $11.25. 249 pages.

AN INVESTIGATION OF BOILING WITH SINGLE AND PARALLEL CHANNEL FLOW

(Order No. Mic 61-1884)

Joseph Daniel Roarty, Ph.D.
University of Pittsburgh, 1961

In multiple channel flow configurations, an interaction among the various parallel flow paths due to non-uniformities in distribution of heat and flow or hydraulic resistance may result in a redistribution of flow and possible unstable flow condition. This is termed the parallel channel effect. If boiling is present in some of the parallel channels, the associated hydraulic resistance is increased considerably in those channels. The problem to be investigated in this research is the effect of differences in single and parallel channel flow on pressure drop, heat transfer, and departure from nucleate boiling or burnout condition under boiling conditions.

Experiments were conducted to investigate the parallel channel effect with water flowing upward through a heated round tube (0.156" I.D. x 21" long) test section, arranged in parallel with an unheated bypass to simulate the multiplicity of flow paths in a parallel channel configuration. Single channel flow heat transfer, pressure drop and DNB data were obtained to compare with the parallel channel results. Ranges of test conditions are as follows: inlet temperature, 100-200°F; heat flux, 0-165,000 Btu/hr-ft^2; mass velocity, 100,000-1,500,000 lbs/hr-ft^2; system pressure, 75 psia.

Results of these experiments indicate that under steady state conditions, heat transfer and pressure drop behavior are approximately identical in single and parallel channel flow systems. Departure from nucleate boiling (DNB) heat flux results with parallel channel flow are generally lower than the single channel flow DNB heat flux results at similar test conditions. This difference is explained by the observation of flow instability or chugging under parallel channel flow conditions at or near incipient burnout.

A semi-theoretical model to predict the departure from nucleate boiling heat flux is derived and compared with experimental data over wide ranges of heat flux, flow, pressure, and geometry. This model is developed on the basis that the DNB heat flux is composed of two components, the heat flux necessary to produce local boiling, plus an additional amount of heat flux to produce a unique enthalpy distribution in the fluid, characteristic of the departure from nucleate boiling condition.

A correlation of the enthalpy distribution in terms of the Reynolds Number of the bulk liquid is similar to an inverse velocity distribution which is present in single phase flow. Absolute value of the fluid enthalpy in contact with the heat transfer surface at the DNB heat flux approximates the saturated vapor value for the range of mass velocities generally encountered in design applications. Microfilm $2.75; Xerox $6.80. 141 pages.

TRANSPORT PROCESSES IN TWO-PHASE TURBULENT FLOW

(Order No. Mic 61-1126)

Chang-Lin Tien, Ph.D.
Princeton University, 1959

The basic mechanism of momentum transport in a two-phase flow field, i.e., solid particles in a fluid medium, is further studied as a complement of previous works. A knowledge of the decaying processes of turbulent motion in the solid phase is obtained. Statistical relations are obtained in closed forms such that the correlation, scale and intensity of one phase can be calculated from those of the other phase. The wall interference on the two-phase turbulent motion is discussed.

The basic mechanism of heat transport in a two-phase flow field is studied in a similar manner to that of the momentum transport case by use of the statistical theory of turbulence. The equation governing the temperature field is of the same type as in the momentum transport case. Statistical relations between the properties of the two phases are studied. An idealized case is used as an illustrative example to show the close relationship between temperature fluctuation properties and velocity fluctuation properties.

The practical importance of a two-phase heat transfer system can not be fully realized without considering the mean properties of the heat transfer system. Analysis is made on the heat transfer of a turbulently flowing fluid with suspended solid particles in a closed conduit. Radiation between the wall and the solid particles is taken into account. The governing equations for the system under consideration are two coupled non-linear equations. Approximations are made for the linearization of the system, and after transformations, the governing equations with their boundary conditions reduce to the Sturm-Liouville type. Computations of the solution are accomplished by the variational aspect of the eigenvalue problems and by the application of Ritz method. The final results are compared with existing experimental data and are discussed.

Microfilm $2.75; Xerox $5.00. 99 pages.

FATIGUE CRACK PROPAGATION IN CUBIC METALS

(Order No. Mic 60-5069)

Robert Peh-ying Wei, Ph.D.
Princeton University, 1960

The rate of fatigue crack propagation for cubic metals under cyclic stresses of various amplitudes, covering the entire range of fatigue life, is calculated based on Stroh's model for crack formation. The results are presented in terms of fatigue life for given cyclic stress amplitudes, i. e., in terms of cycles to failure at a specific stress level vs. applied stresses. Their significance in the case of cyclic loading at elevated temperatures, temperature cycling, thermal shock and impact is discussed. A comparison with experimental results is presented.

Microfilm $2.75; Xerox $5.00. 99 pages.

ENGINEERING MECHANICS

A CONTRIBUTION TO PHOTOELASTIC STRUCTURAL STABILITY ANALYSIS

(Order No. Mic 61-2356)

William Louis Bingham, Ph.D.
The Pennsylvania State University, 1961

Recent advances in increasing the strength of materials compared with the negligible increases in elastic moduli, has made the study of structural stability more important than ever. Further, the geometrical configurations of structures have become so complex that the solutions of stability problems are practically inaccessible to mathematical methods.

Since photoelastic methods generally produce more comprehensive experimental evidence than most techniques of experimental strain analysis, a survey was made to exhibit the potentialities and weaknesses of various photoelastic techniques. From this, the differential photoelastic strain gage emerged as the technique usable on the greatest variety of buckling problems. In order to observe the strain distribution at the antinodal point, which in general might occur at any position along the gage it is necessary to effect a "line" bonding of the element to the structure.

A new photoelastic measuring element which would eliminate the difficulty of achieving a line bond was conceived, manufactured and tested. This element which is observed parallel to the surface to which it is attached, also has the potential of being more sensitive to the bending strains of buckling than the differential photoelastic strain gage, if more precise compensation were used in conjunction with it.

This new type of photoelastic measuring element, attachable to prototypes as well as laboratory models, is demonstrated on two well-known problems--the fixed-end and the free-end Euler column--to show its utility and validity.

Another significant result emerged from the experiments on the Euler columns concerning the reading of the average strain in the photoelastic strip by a simple observation normal to the surface. It is shown both mathematically and experimentally that difference between the true and the observed average strain may be as large as 100% if the Poisson's ratios of the structure and the photoelastic element differ.

The local buckling of a sheet in tension with a central rectangular opening was studied. The photostrip was used to determine the effect of the corner radii of the central rectangular opening on the local critical buckling stress. This problem has not previously been investigated either experimentally or mathematically. (The photographic records of the isochromatic patterns as observed parallel to the surface are actually obtained from a normal direction by using a mirror for rotating the image 90°.) It is shown that increasing the corner radius increases the critical buckling load at an increasing rate which is not similar to the character of the effect of stress concentration in the corners on the maximum allowable load. A consideration of the latter effect shows that increasing the corner radius increases the maximum allowable load at a decreasing rate.

Microfilm $2.75; Xerox $6.60. 137 pages.

STRAIN AGING EFFECTS IN SAE 1018 STEEL & ARC-CAST MOLYBDENUM

(Order No. Mic 61-90)

George William Brock, Ph.D.
University of Illinois, 1960

An investigation has been made on an annealed SAE 1018 steel and recrystallized molybdenum in order to further explore the phenomena known as strain aging. Experiments in the form of fatigue tests, elevated temperature, tension tests and the aging of overstrained tension specimens, has been carried out.

The results obtained from the steel specimens suggest that aging is accompanied by (a) an increase in the yield points with aging time, (b) an increase in the ultimate strength with aging time. The difference between the activation energies associated with these two processes corresponds very closely to the difference between the activation energies for the diffusion of carbon in alpha iron as measured by the internal friction pendulum, and by the rate of precipitation of carbide in alpha iron. Within the limits of experimental error, it has been found that the activation energies for the diffusion of interstitial atoms in alpha iron is unaffected by plastic deformation in the lattice. The data obtained from the aging of overstrained steel tension specimens has shown a marked similarity in the kinetics of the upper and lower yield point.

The activation energy associated with stress frequency and temperature, for maximum strengthening in fatigue due to strain aging, has been discussed in terms of recent experimental observations.

An analysis of the elevated temperature tension tests on molybdenum has shown that its weak strain aging behavior is probably due to its low solid solubility for the common interstitial elements, and furthermore, each interstitial element present in molybdenum seems to affect the tensile properties over some temperature range. An approximate method is suggested for calculating activation energies for interstitial diffusion in the refractory metals, from a knowledge of their tensile behavior at elevated temperature.

Experiments on the aging of overstrained molybdenum tension specimens have shown that strain aging in molybdenum depends to a marked degree on the amount of plastic strain in the lattice, this being a result of the low solid solubility for interstitial elements in molybdenum.

One of the activation energies associated with the return of the yield points in overstrained molybdenum was found to be 36,300 cals/mol. This is thought to be the activation energy associated with the diffusion of carbon in molybdenum.

Microfilm $2.75; Xerox $4.00. 73 pages.

A SLIP-LINE THEORY OF PLASTICITY

(Order No. Mic 61-2384)

Richard Edward Llorens, Ph.D.
The Pennsylvania State University, 1961

This thesis attempted to construct a theory of an ideal elastic-plastic material with no work-hardening. On the

basis of the known discontinuous nature of slip at the microscopic level in metals, the problem of plasticity was assumed to be hyperbolic. For the continuum model adopted, this was interpreted to mean that discontinuities in the first order partial derivatives of stress and strain could exist. Mathematical difficulties limited the investigation to the general solution of the problems of generalized plane strain and axial symmetry. Physical evidence indicated that, for metals, two characteristic systems were particularly useful and the stress and strain problems became mathematically uncoupled. Both problems yielded stress-strain laws of the flow type when coincidence of the stress and strain characteristics were assumed. The stress equations were then transformed using the mean pressure in the plane of flow and the inclination of the principal stress direction as variables. The method of characteristics was adopted and the stress compatibility equations were expressed in terms of the characteristic angles. Finally, the deformation problem was considered by transforming the velocity equations to a coordinate system which used the tangent and normal to a characteristic.

The general theory was restricted, for the problem of axial symmetry, to the simplest mathematical theory consistent with the von Mises yield condition. This procedure led to the introduction of the well-known Haar-Karman full plasticity condition. The remainder of the thesis was devoted to the numerical solution of the indentation of a large plate between two rough circular dies. This included a computer solution of the associated stress problem for four ratios of thickness of plate to diameter of die and a typical velocity solution which proved the admissibility of the solution. Microfilm $2.75; Xerox $6.40. 131 pages.

ENGINEERING, METALLURGY

A STUDY OF THE EFFECT OF CERTAIN RARE EARTH ELEMENTS ON THE ALPHA-BETA TRANSFORMATION OF ZIRCONIUM

(Order No. Mic 61-982)

Louis C. Ianniello, Ph.D.
Rensselaer Polytechnic Institute, 1960

Supervisor: Arthur A. Burr

The allotropic transformation in zirconium and zirconium-rare earth alloys was studied by dilatometry. Binary alloys of Nd, Y, Dy, Ho, and Er were vacuum arc melted and cold swaged to suitable sizes for dilatometric and electrical resistivity measurements.

Zirconium transforms from HCP structure to a BCC structure upon heating at about 862°C with an accompanying volume contraction. The elements studied all raised the temperature of the midpoint contraction and hence all raised the allotropic transformation temperature.

The allotropy of Zirconium has been considered from the point of view of the effect of temperature on the Fermi energy level. The effect of the rare earths on the allotropic transformation temperature was explained by their electronic character and influence on the Fermi energy level of the alloys. Electrical resistivity and superconductivity measurements were performed on the alloys and were in accord with the hypothesis.

Microfilm $2.75; Xerox $4.60. 86 pages.

THE STRUCTURE OF A GUINIER-PRESTON ZONE

(Order No. Mic 61-2512)

Alvin David Thomas, Jr., Ph.D.
Purdue University, 1961

Major Professor: Pekka Rautala

The phenomenon of age hardening in aluminum-copper alloys has been extensively investigated since its discovery at the turn of this century. The application of x-ray techniques to the study of aging has led to important discoveries concerning the structures involved at the various stages in the process. Qualitative interpretations of the x-ray diffraction pictures have established that in the early stages of aging at low temperatures a copper-rich, two dimensional zone, the so-called Guinier-Preston zone, forms parallel to the (100) planes of the aluminum matrix. Only recently have attempts been made to analyze the intensity distributions on the diffraction films quantitatively to establish the structure of these zones.

In this investigation, the Fourier analysis of the scattered amplitude function associated with the Guinier-Preston zones was used to determine their structure. The Stieltjes planimeter was employed in a trial and error solution to extract the electron density distribution in the zone.

The average Guinier-Preston zone was found to consist of three copper-rich layers, the center layer containing 75 atomic percent copper and a layer containing 35 percent copper on either side. The average zone diameter was found to be 120 Å. The first layer is displaced 0.25 Å toward the center of the zone and no displacement was found to exist in the remaining layers of the zone.

Microfilm $2.75; Xerox $5.20. 101 pages.

ENGINEERING, MINING

MECHANISM OF ROCK FAILURE UNDER IMPACT OF A CHISEL-SHAPED BIT

(Order No. Mic 61-2400)

Madan Mohan Singh, Ph.D.
The Pennsylvania State University, 1961

Incredible though it may seem, little is known regarding the mechanism of rock failure under dynamic loading in spite of the extensive exploitation of impact to achieve fragmentation, penetration, and comminution in the mineral

and construction industries. A thorough comprehension of the impact loading process is especially pertinent to drilling, for example, since the impact of a chisel edge on rock constitutes the fundamental action involved in the most prevalent methods of rock drilling.

Previous investigations have indicated that mechanical methods of drilling offer the best means of penetrating rock for the present and near future. Since the process of rock drilling is a very complex operation, the study of single, isolated blows of a chisel on rock serves as a logical beginning for investigations leading to a grasp of the phenomenon of rock failure under impact. Therefore, experimental studies were conducted with single blows on a specially prepared synthetic rock and confirmed by tests on Barre granite, Solenhofen limestone, and lucite (plexiglass). The transient strain pulses traversing through the rock were detected with the aid of strain gages amplified through oscilloscope circuits. The effects of indexing, repeated blows, bit design, uneven surface, bottom-hold conditions, method of flushing, properties of the flushing fluid, method of application of energy and a host of other factors, for example, were not considered.

An analysis of the observations brought to light that rock behavior when struck by a chisel should be properly classified as viscoelastic rather than elastic. This emphasizes the differences between the shapes of strain pulses detected on the bit and on the rock, and the error of drawing conclusions about the rock failure process from studies of pulses through the bit. It is also possible to obtain the configuration of strain energy and stress distribution on the rock surface around the area of impact.

The studies suggest that crater formation in rock is effected by a sequence of events: the crushing of surface irregularities, the dilation of the surface due to indentation, the formation of tension fractures owing to running cracks, and the shearing of rock chips due to the existence of a von Schmidt headwave. The fragmentation of the rock is caused by the complex system of high stresses induced in an essentially inhomogeneous material. Thus, although the failure pattern depicted by the rock due to dynamic loading closely resembles the configuration when it fails due to static loading with the same tool, the two processes are not identical and differ substantially in their mechanics.

A system of rock classification dependent on the acoustical impedance of rocks is proposed for use in drilling. It would be possible to devise a "drillability" scale on this basis.

Reliable empirical relations can be established between the crater dimensions, blow energy, and blow velocity, provided a sufficient number of tests is conducted on a large variety of rocks as a source of data. It appears that the distinct phases in failure exhibited by semi-ductile rocks are not shown by brittle materials. The coupling of the impacting and impacted bodies in a system seems to play an important role in determining the extent of damage caused by a blow.

The surface energy of new rock particles or cracks formed and the energy of permanent deformation as shown by the residual strains that remain in the rock are the chief sources of energy consumption in the rock failure process. A quantitative energy determination of the proportion of energy consumed by these events would be of considerable benefit in attempts to eliminate sources of energy waste and to gain a better understanding of rock penetration. Microfilm $2.75; Xerox $7.60. 162 pages.

ENGINEERING, NUCLEAR

NUCLEAR AND THERMAL DESIGN CONSIDERATIONS FOR SOLUBLE-POISON CONTROLLED NUCLEAR REACTORS

(Order No. Mic 61-981)

Peter L. Hofmann, D.Eng.Sci.
Rensselaer Polytechnic Institute, 1960

Supervisor: E. R. Gaerttner

The use of dissolved neutron absorbers, "soluble poisons" for the control of nuclear power reactors is examined. The investigation is restricted to the nuclear and thermal core design area. The only reactor type that is given consideration is the completely enriched, pressurized water reactor. It is supposed throughout, that reactors controlled in this way could be utilized in small power stations.

In this study, reactor size, reactor composition (metal-to-water ratio), power level and endurance are varied and the effects of these variations on the nuclear requirements and steady state thermal performance are examined. The results are compared with similar quantities arising in the analysis of completely rod controlled reactors, as well as reactors controlled by means of control rods and so-called "burnable poisons." The cylindrical core sizes considered have diameters between 2 ft. and 4 ft. and comparable core heights. The reactor powers range from about 10 MW to about 100 MW.

Use of soluble poison control for small, fully enriched, low power (near 10 MW), high endurance (20,000 to 40,000 full power hours) reactors appears to be attractive, particularly if burnable poisons are used as supplementary shim control.

A comparison of the thermal capabilities of completely soluble-poison controlled and completely rod controlled reactors shows a power density advantage of about 3:1 in favor of the soluble-poison controlled core. If burnable poisons are used in both reactor types for supplementary control, this power density advantage is reduced to about 2:1.

The flatter fuel burnup in soluble-poison controlled cores makes higher endurances achievable in the soluble-poison controlled core. For a limited range of small, low power cores, this endurance advantage is near 2:1 compared to the rod controlled reactor.

Use of complete soluble poison control for large, high power (near 100 MW), high endurance reactors does not appear to be indicated, since difficulties with operating temperature coefficients might arise.

Microfilm $2.75; Xerox $8.20. 177 pages.

ENGINEERING, SANITARY AND MUNICIPAL

JOINT OPERATION OF GRAVITY RESERVOIRS AND PUMPED SUPPLIES

(Order No. Mic 61-1901)

Merton Joseph Willis, D.Eng.
The Johns Hopkins University, 1961

This study of methods of operating a municipal water collecting system consisting of a group of upland impounding reservoirs of limited yield, supplemented by a low level pumped supply of relatively unlimited yield is a study of the city of Baltimore's water collecting system as it will be constituted when the projected aqueduct from the Susquehanna River at Conowingo Dam to the city is completed in 1962. Studies of draft regulation of gravity water supply from the upland reservoirs, supplemented as needed from the supplies of water pumped through the Susquehanna Aqueduct, have led to the development of concepts and techniques whose application should assure delivery of the required volumes of raw water to the city filter plants at minimum operating cost. The "firming" concept shows that when an upland supply is supplemented by a pumped supply whose source has a relatively unlimited yield, the risk of running out of water is so greatly reduced that the safe yield from the upland supply can be increased by a considerably greater amount – over the long run – than any necessary increase in supplementary pumping to firm. Several methods of reservoir operation when firming have been studied and "storage depletion-frequency curves" have been developed to implement the "firming" concept for such combined systems.

The regulation of drafts from upland reservoirs without firming, arranged both singly and in parallel, has also been studied, using the "storage depletion-frequency" curves. Application of the techniques which have been evolved should help to advance knowledge of the control of drafts from complex combinations of upland gravity reservoirs and supplementary lowland pumped supplies, with the assurance that adequate volumes of water will be delivered at minimum cost.

Microfilm $7.45; Xerox $26.35. 585 pages.

FINE ARTS

A STYLISTIC ANALYSIS OF ARSHILE GORKY'S ART FROM 1943-1948

(Order No. Mic 61-2222)

Robert Frank Reiff, Ph.D.
Columbia University, 1961

This dissertation is a study of the style of the American artist Arshile Gorky from 1943 to the time of his death five years later. The following topics are considered, with a chapter devoted to each: forms and their expressive content, space and composition, color, the influences affecting Gorky's style, and an evaluation and conclusion.

Gorky's last pictures are non-representational and their character depends largely upon forms and the use of forms. For a better understanding of how these forms function, they were isolated, categorized, and described. Gorky preferred to limit himself to a few general forms such as ovals and warped rectangles. In general, his forms are curvilinear, biomorphic, and appear opaque. They join with one another easily and assume thematic significance because they recur frequently in the same work and from work to work. Although they can be found in rudimentary form in Gorky's earliest works, Gorky depended heavily on the art of Picasso, Miró, and Matta, in particular, for clarification of his ideas. Allusions in forms to low biological life and human organs are not sufficiently precise to permit positive identification. An interpretation of the emotive content of Gorky's forms as a reflection of his personality and environment concludes the first chapter.

The conception of space in Gorky's pictures depends largely upon the beholder. Space may appear shallow, having characteristics common to both landscape and still life, or it may seem that forms relate to the area surrounding them as figures do to a ground. The illusion of depth arises from suggestions of planes in perspective. Scale is suggested by the size and number of shapes in relationship to the picture's dimensions. When considering composition, the large, over-all ordering of parts was analyzed as well as the relationship of one form unit to another. The wave curve motif dominates the total scheme of most pictures, while individual forms are related to one another by dynamic rhythms, making them interdependent. Gorky did considerable planning and reworking in developing his pictures. Synthetic cubism influenced him in forming his concept of composition.

Gorky had an instinctive feeling for color, yet he cannot be considered a colorist because color is not crucial to his art. His color does not recall that of another. He favored tertiary colors. Frequently, he added white to colors to give the picture a tonal cohesiveness and a posterish quality. Black occurs in nearly every work. He may be the first artist to paint an all black and white work without intending it to be a grisaille. He organized color by means of contrast rather than gradation or tone. Color often assists in suggesting movement and contributes, therefore, to dynamic properties of the composition.

Influences which dominated Gorky's art are many. He has been accused of being a mere imitator. I believe that he did not submit to influences from poverty of purpose or idea: he took only what he needed.

In attempting to establish Gorky's place in art, I compared him to his contemporaries and decided that his work was superior to any being done in 1960 by any European or American under fifty years of age, and on a par with the best of his generation, Jackson Pollock, Mark Tobey, Philip Guston, Clyfford Still, and Mark Rothko. Thwarted by the provinciality of his artistic environment and the

narrowness resulting from his almost obsessive involvement with his own problems as an artist, he never achieved the largeness of spirit characteristic of such masters as Picasso, Matisse, and Miró.

Microfilm $4.95; Xerox $17.55. 386 pages.

THE POSITION OF LA MARIEE MISE A NU PAR SES CELIBATAIRES, MEME (1915-1923) IN THE STYLISTIC AND ICONOGRAPHIC DEVELOPMENT OF THE ART OF MARCEL DUCHAMP.

(Order No. Mic 61-2004)

Lawrence D. Steefel, Jr., Ph.D.
Princeton University, 1960

As a dada artist, Marcel Duchamp engages the perceiver of his art in a baffling game whose protean rules emerge only in the process of play. The spectator is challenged by an infinite labyrinth of puzzles, puns, parodies, paradoxes, and problems which the artist himself ironically refuses to define or acknowledge conclusively. We may reasonably regard such an artist as irresponsible and his art as a nonsensical statement of intellectual agnosticism. Agnosticism, however, may be a skeptic's way of accepting disorder in the world. Total agnosticism may also provide the occasion by which the perceiver can construct a cathartic moment of hallucinatory allégresse, a "beauty of indifference" in which refractory materials and mental strife are converted into a consummatory moment of esthetic delight.

This thesis proposes that a meaningful interpretation of the formal and iconographic structure of Duchamp's art can be developed which ligitimately supports the hypothesis of a resolution of incompatibles as at least one logical consequence of playing Duchamp's game. While this is not the only operational orientation which Duchamp offers us, it is an important and neglected option which previous criticism has either denied out of hand or has claimed without supporting evidence drawn from the structure of the work itself. Actually there are two dialectically interactive contexts to this art. Its dual character emerges as (1) an imaginative image of cultural disorder and (2) an instrument by which this disorder may be transcended.

By isolating a number of basic themes and contexts (the machine, eroticism, the dynamism of motion, and paradox as an existential fact of life) and then studying their interaction with the formal structure of art, it is possible to show surprising continuities of development and purpose throughout the esoteric transformations which convert an Impressionist amateur into the "radiant figure of Marcel," "gadgeteer of the unconscious," "mysterious as the internal changes of a star."

Using Duchamp's masterpiece La Mariée mise à nu par ses célibataires, même (1915-1923) as a heuristic focal point, we find significant personal attitudes towards nature, society, and the creative act emerging from the complex structure of his work. Such an analysis helps us to gain new insights into individual works, see new relationships between different works, and establish the relevance of the art as a whole to common preoccupations of other artists and poets of the modern era. Using both conventional procedures of stylistic and iconographic analysis and more experimental hypotheses of perceptual behavior and the heuristics of symbolic thought, this thesis undertakes to examine the experiential roots of Duchamp's art. The artist's inventive response to problems of psychological dissociation, esthetic absolutism, ideological commitment, and existential anxiety is personal and unique, but it throws light on critical problems of value which should be of interest to any serious student of modern art. By regarding Duchamp's work as an imaginative strategy of self-transcendence, we find artistic value in a "dehumanized" imagery without implausibly distorting the independence of Duchamp's art as an esthetic expression of a dada personality. In this way, the art of Marcel Duchamp is not passed over as the eccentric joke of an anarchical freak, but assumes status as a major accomplishment of an important figure in the mainstream of modern art.

Microfilm $6.30; Xerox $22.30. 493 pages.

SPECTROPHOTOMETRIC ESTIMATION OF METMYOGLOBIN IN FROZEN MEAT EXTRACTS

(Order No. Mic 61-2699)

John Perry Lane, Ph.D.
Michigan State University, 1961

Major Professor: Lyman J. Bratzler

The changes in the oxidative state of myoglobin, the primary pigment of lean muscle, are directly associated with changes in the color of lean meat. Townsend (1958) reported that fluorescent lights accelerated the rate of color deterioration and the formation of metmyoglobin in beef steaks packaged in a transparent wrapper and stored at 0° F.

The present study was initiated to determine if frozen meat extracts would react to light in a manner similar to meat cuts. The use of water extracts would provide a series of samples with greater homogeneity than was obtainable by using replicate cuts of meat. Another objective of this study was to adapt the spectrophotometric method as described by Mangel (1951) and Townsend (1958) to the estimation of the per cent metmyoglobin in the frozen meat extracts. Finally, investigations were conducted in an attempt to inhibit or characterize the light-catalyzed increase in the rate of metmyoglobin formation of the frozen solutions.

The solutions were prepared by blending portions of beef rounds with eight parts distilled water. The solutions were then centrifuged, filtered and frozen. The samples were stored at 0° F. in either a walk-in freezer under 25 foot-candles of fluorescent illumination or in a frozen food display case under approximately 60 foot-candles of light. The samples were periodically removed, thawed and analyzed in a Beckman DU Spectrophotometer. From the optical density the per cent metmyoglobin was estimated. The effects on the frozen solutions of: fluorescent lights; dialysis; addition of the concentrated dialysate; addition of various metal ion solutions; and addition of glucose were observed.

Frozen meat-water extracts served as a satisfactory medium for following the increase in per cent metmyoglobin. The spectrophotometric method previously referred to proved satisfactory for estimating the per cent metmyoglobin in the solution. It was observed that fluorescent lights caused a significant increase in the formation of metmyoglobin in the solution, similar to that reported for frozen steaks.

Dialyzing the extract inhibited the increase of metmyoglobin in the frozen solution when stored under light. Addition of copper, manganese or calcium ions in the form of the chloride salts to the dialyzed solution did not cause an appreciable increase in the rate of metmyoglobin formation. The addition of chloride salts of magnesium and iron contributed to an increase in the rate of metmyoglobin formation.

When the dialysate was concentrated and added to the dialyzed residue there was a significant increase in the rate of metmyoglobin formation. The addition of one cc. of a 1% or 2% solution of glucose to an undialyzed solution did not inhibit metmyoglobin formation in meat solutions when frozen and stored under light.

REFERENCES

Mangel, Margaret. 1951. The determination of methemoglobin in beef muscle extracts. Mo. Res. Bul. 474: 1-24.

Townsend, William E. 1958. Effect of temperature, storage condition and light on the color of prepackaged frozen meat. Unpublished Ph.D. thesis, Michigan State University, East Lansing, Michigan.
Microfilm $2.75; Xerox $5.80. 118 pages.

A STUDY OF CERTAIN PHYSICAL AND CHEMICAL PROPERTIES OF CHICKEN EGGS IN RELATION TO THEIR INITIAL ALBUMEN QUALITY AND TO SOME CHARACTERISTICS OF THE HENS WHICH LAID THEM

(Order No. Mic 61-2159)

James Herbert Skala, Ph.D.
University of Minnesota, 1961

Adviser: Milo H. Swanson

Attempts to influence initial interior egg quality by genetic or nutritional approaches have either failed or have been frustrated by undesirable side effects. The major objective of this study was to obtain further information concerning eggs of different initial interior quality to supplement present limited information and possibly to indicate the cause or origin of the variation normally encountered.

Eggs were obtained from selected White Leghorn hens (commercial strain) producing higher quality eggs (averaging about 95 Haugh Units) and an equal number producing lower quality eggs (averaging about 80 Haugh Units) in a replicated study.

Higher quality eggs were significantly (t-test) larger than the lower quality eggs (59.79 vs. 57.43 grams) with significantly more albumen or white (34.45 vs. 32.66 grams) and the same amount of yolk (17.04 vs. 17.26 grams).

Whole albumen from higher quality eggs contained a significantly larger proportion of middle thick albumen

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

(61.04%) and a significantly lower proportion of outer thin albumen (22.36%) compared with lower quality eggs (55.80% and 24.73%, respectively). The proportion of inner thin white (16.70%) of the higher quality eggs was lower than that (19.47%) of the lower quality eggs (significant at a slightly lower level of probability).

Higher quality eggs contained a significantly higher concentration of total solids in the whole albumen (12.54% vs. 11.28%), predominantly located in the inner thin (14.60% vs. 12.87%) and middle thick (12.69% vs. 11.70%) albumen layers. No difference was noted in the outer thin layers in this regard.

Total nitrogen concentrations paralleled total solids concentrations in whole albumen and albumen layers; the same differences were noted relative to egg quality.

No differences could be detected in the pH of the middle thick albumen, or in the total ash and sodium content of the whole albumen of eggs of different initial quality.

No difference was noted in the composition of the total protein in whole albumen or in albumen layers of different quality eggs in terms of five major protein groups as determined using a horizontal open strip paper electrophoresis technique for analysis.

No difference was noted in the ovomucin concentration (% of total protein) in whole albumen of eggs of different initial quality, as determined by a precipitation technique. Ovomucin comprised a significantly larger proportion of the total protein of the middle thick white (4.98%) of higher quality eggs than in lower quality eggs (4.48%). The inner thin white of the higher quality eggs contained a smaller proportion of ovomucin (3.37% of total protein) than the lower quality eggs (3.76% of total protein), significant at a slightly lower probability level. The ovomucin content of the outer thin white layers did not differ significantly relative to quality.

These results suggested that the original concentration of the constituents of the albumen (predominantly protein) may influence the extent of formation of the various layers of white and distribution of ovomucin, and ultimately the quality level of the finished egg.

Measurement of feed intake suggested that birds laying higher quality eggs required more feed (103.0 grams) to produce 100 grams of whole egg than did birds laying lower quality eggs (85.7 grams), excess over estimated maintenance requirement.

Plasma protein levels and blood pH of the hens indicated no relationship to quality of eggs laid by these hens.

Microfilm $2.75; Xerox $6.00. 123 pages.

FACTORS ASSOCIATED WITH THE FLAVOR OF POULTRY MEAT

(Order No. Mic 61-2511)

John Valentine Spencer, Ph.D.
Purdue University, 1961

Major Professor: William J. Stadelman

Tests were conducted to study the nature and origin of those flavor constituents which serve to identify chicken meat. Factors such as age and diet of bird were studied for their effect on the over-all intensity of flavor in chickens.

The dialyzate of raw chicken meat does possess constituents which permit identification of the species. Beef and pork apparently do not carry this same factor. When heated, the dialyzate of raw beef possessed constituents which characterized this species. Either cation or anion exchange removed or destroyed identifying constituents suggesting that ampholytes or both acidic and basic components may be involved. Nitrogen containing ninhydrin positive compounds as well as carbohydrates were present in the raw dialyzate of chicken meat.

Ion exchange tests appeared to rule out either cationic or anionic inorganic constituents as major contributors to this component. Neutral constituents, in the concentrations tested, were found to be devoid of taste.

The fatty layer separated from meat broth contained constituents which characterized the species. When this layer from either chicken or beef broth was included the ability to identify the species was improved. The fatty layer from pork broth lacked this quality, indicating that the characteristic constituents carried by broth fat were not extracted by hot water to the same extent as chicken or beef. On the other hand, solvent extraction removed characteristic pork flavor constituents to the extent that a broth prepared from solvent extracted meat could no longer be recognized as pork. Chicken and beef meat retained the characteristic constituents of flavor after solvent extraction.

Except for beef, cation or anion exchange did not remove components in broth prepared from solvent extracted meat which could be identified by taste but did remove those which permitted identification by aroma. With beef, anion exchange did not remove components which permit identification by aroma.

The volatile gases which evolved from simmering meat either did not carry a component characteristic of the species or the flavor was masked by a sulfide odor and taste common to chicken, beef and pork.

Varying the fat content of diets fed to chickens affected the intensity of flavor of either uncooked fat or broth fat but did not affect the flavor of the aqueous layer of broth. Essentially fat free diets imparted lower flavor intensity than diets including fat. When the fat from young and from mature chickens were compared fat from young chickens was least intense in flavor.

Microfilm $2.75; Xerox $6.40. 131 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

AGRICULTURAL SETTLEMENT IN BRITISH HONDURAS: A GEOGRAPHIC INTERPRETATION OF ITS DEVELOPMENT.

(Order No. Mic 61-2229)

Allen David Bushong, Ph.D.
The University of Florida, 1961

This study is a geographic interpretation of an American tropical lowland that has as its central theme the evolution of agricultural settlement in British Honduras and the interplay of physical factors and cultural forces that have shaped the contemporary agrarian landscape.

Field research for this study was undertaken in British Honduras in the summer of 1959. All sections of the colony were visited. Extensive secondary sources and the files of various government departments were analyzed. The combined data obtained from field observations and numerous printed and manuscript sources have made feasible a space-time analysis of British Honduran agricultural settlement.

The study is divided into four parts. Part one presents the general setting of the study area. The physical geography is presented in the five chapters of part two. The seemingly static physical factors and dynamic human forces operative in the past are analyzed in the four chapters of part three to show their influence in fashioning the present mode of rural life. Part four is the core of the study and focuses its attention on the human and economic aspects of the present agricultural milieu.

Since the initial occupance by the English in the seventeenth century of what is now British Honduras, agricultural activities have occupied a secondary position to forest-oriented occupations. Agriculture remained entirely at a subsistence level until the middle of the nineteenth century before any crop was grown in commercial quantities. There have been numerous agricultural settlement ventures throughout this three hundred year period. Almost all of these have been modest in size and undertaken with a minimum of planning. In most cases the government has extended its good will and aid as far as possible, however small in amount. Many agricultural settlements failed despite government assistance. Some failed because of physical adversities. Most failed, however, because of the difficulty of producing for the world market crops that could compete favorably with those from other areas. Less efficient production in British Honduras coupled with inadequate internal and external transportation and marketing arrangements have done, and continue to do, much to thwart a more rapid development of British Honduran agriculture.

Most farmers in contemporary British Honduras are shifting agriculturalists for whom farming is a part-time occupation. Only one-tenth of the 90,000 British Hondurans are full-time farmers. Less than 2 per cent of the colony's area is given over to permanent agricultural land use. Citrus and sugar cane, both under the protection of a United Kingdom quota, are the leading commercial commodities, while cattle and coconuts are slowly increasing in importance. The greatest success in agriculture has been, and gives every appearance of continuing to be, in the large-scale enterprises which are controlled by a few individuals or companies from outside the colony. This same handful of owners controls most of the freehold property in British Honduras. Small-scale, full-time farmers, which the government is striving to foster, are conspicuous by their absence in British Honduras.

Immigration is encouraged and aided financially by the government, which also gives generous concessions to group agricultural colonization. Land is still inexpensive and easy to obtain, and land taxes remain low. The goal of attracting 7,000 immigrants per year appears unrealistic. The colony never has received more than 1,300 immigrants in any year in its history. Most encouraging for future small-scale farming is the influx of 2,500 Mennonites, largely from Mexico, who came to the colony in 1958 and 1959, for if the efforts in agriculture of this religious group are successful, others may be stimulated to engage in full-time farming.

Microfilm $3.10; Xerox $10.80. 240 pages.

SOME GEOGRAPHIC ASPECTS OF PLANTATION AGRICULTURE IN YUCATAN

(Order No. Mic 61-2137)

Roland Emanuel Paul Chardon, Ph.D.
University of Minnesota, 1961

Adviser: Jan O. M. Broek

The plantation, as an agricultural type, has many variants. This investigation is a study of one of these – the henequen hacienda – in a region which has experienced radical changes in the organizational aspects of its plantation type; the study concentrates on:

(1) the henequen hacienda as it developed in northwestern Yucatan, and its place in the plantation concept.

(2) the effects of Mexico's land reform on the henequen hacienda and the Henequen Zone.

(3) geographic relationships between plantation and nonplantation agriculture in the Henequen Zone.

(4) factors determining the Henequen Zone's location within Yucatan.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

Selected case studies involving 14 haciendas and one communal producer were made and, although not a statistically significant sample, are considered by the author to be quite representative of the henequen hacienda in general.

The henequen hacienda evolved slowly from the Colonial maize-livestock subsistence hacienda. Although the first attempt to establish a commercial henequen-producing farm in 1830 failed, it marked the transition in Yucatecan attitudes from traditional subsistence agriculture, based on land and cattle, to commercial production of a major industrial crop. While often considered a response to widespread use of binder twine in the McCormick reaper in 1878, henequen production in Yucatan actually began its development from 1830 onward due to local initiative, utilizing a local economic unit, a local plant, local methods of cultivation, and a local decorticator. With the advent of a large foreign market for its production in 1878, the Yucatecan henequen hacienda acquired all the characteristic traits of the plantation type. By 1910, the hacienda, representing private holdings, had virtually absorbed the other two main types of land in Yucatan's Henequen Zone – public and town lands. Due to the Mexican Revolution, hacienda woodlands were expropriated and returned to towns as ejidos in the 1920's. The functional unity of the henequen hacienda was thus not seriously impaired until 1934, when further expropriations provided towns with henequen lands. In 1937, hacienda residents were also provided with henequen lands, thus creating a second class of communal henequen producers. The remaining lands were retained by private owners as residual estates, each amounting to less than 300 hectares. In addition, the owners retained the processing plants.

Lands formerly comprising the typical henequen hacienda now belong to three distinct producers: the communal townspeople; the communal hacienda residents; and the residual estates. Of these, only the last, with few exceptions, own processing plants; other producers contract with private owners for the processing of their henequen. The henequen hacienda, in spite of its present tenurial divisions, has maintained its pre-Revolutionary field pattern. Unfortunately, the lack of agricultural-industrial integration of the crop in the case of many producers, and other problems, has meant that Mexico's Agrarian Reform has had a generally unfavorable effect on the Yucatecan henequen industry.

In addition to henequen, small fields of maize and beans are planted by individuals for two years in burned clearings; the fields are then left to revert to forest, and others are cleared. Yields from these plots are low, and the Henequen Zone is dependent on external sources for almost its entire food requirements.

Location analysis of the Henequen Zone includes a discussion of both physical and cultural factors. It appears that a fortuitous event determined the establishment of the main Spanish settlement at Merida, around which subsequently developed the haciendas.

Microfilm $4.45; Xerox $15.75. 346 pages.

IDENTIFICATION OF PATTERNS ON MAPS WITH SPECIAL REFERENCE TO DATA REDUCTION FOR SYSTEMS ANALYSIS

(Order No. Mic 61-1314)

Michael Francis Dacey, Ph.D.
University of Washington, 1960

Chairman: William L. Garrison

The use of map evidence for incisive, descriptive statements about spatial distributions is an integral feature of geographic research. In terms of their abstract properties, these spatial distributions exist in one of the three lowest geometric dimensions--areas, lines or points. The density and pattern of this geometry may serve as the only descriptive statement, or the many subleties of spatial distributions may be explicitly summarized. Because the map without elaboration is usually insufficient to convey a succinct analysis of the pertinent variables, the researcher reduces observations from the map pattern to a more explicit, descriptive statement.

This study contributes to the concise description of map patterns. New techniques of map analysis are designed. Existing techniques of analysis are explained and illustrated within a geographic context. The application of each technique is illustrated by a map analysis of a representative spatial distribution. These examples demonstrate the efficacy of analytical procedures for the identification and description of map patterns.

Patterns are described by their geometric properties and the scale of measurement in order to group patterns which may be described by similar techniques. One group of patterns is distinguished by a dichotomous scale of measurement. This study is specifically directed to the description of patterns which have a dichotomous or nominal scaling. Since this group of patterns shows solely the existence of objects, map analysis of such patterns provides an interpretation of the spatial distribution only in terms of the presence and nonpresence of the mapped universe.

This design of map techniques is directed to an area of research which requires diverse analytical descriptions. This is the study of the growth and development of the urban complex. The recent use of simulation models within the broader approach of systems analysis presages the eventual solution of many complex, seemingly intractable problems. An important requisite to implementation of this approach is the expression of data in a suitable descriptive form. The reduction of spatial patterns to concise, descriptive statements is required. Each technique contributes to this objective.

Microfilm $2.75; Xerox $6.60. 140 pages.

INDUSTRIAL DEVELOPMENT IN WESTERN SIBERIA, A GEOGRAPHICAL ANALYSIS

(Order No. Mic 61-1495)

Richard Ellis Lonsdale, Ph.D.
Syracuse University, 1960

Supervisor: George B. Cressey

This study surveys and analyzes the evolution of Western Siberia's industrial geography from the pre-Revolutionary prevalence of small-scale cottage enterprises to the present dominance of large-scale heavy industry. Specifically, the objectives of this study are stated in terms of the following two questions:

1. How has the industrial geography evolved from the Tsarist period to the present day?
2. How has industrialization affected the geography of Western Siberia?

Answers to the above basic questions were sought through an examination of data on the changing distribution, size, and structure of industry, and on population, transportation, and other aspects of Western Siberia's geography affected by industrialization. An inventory of raw materials was made and the Soviet industrial location philosophy examined. This permitted conclusions regarding the nature and basis of changes in the industrial geography, the relationship between Soviet locational planning principles and actual practices, industrialization as an agent of geographic change, and the national importance of Western Siberian industry and its future prospects.

The evolution of Western Siberia's industrial geography has been characterized by extensive changes in the location, scale, and type of production. Industry has shifted eastward from a nineteenth century concentration in the Tobol River Basin to a later focus on the Kuzbass and adjacent areas. Coal has replaced farm products as the dominant raw material for industry, and has permitted the development of metallurgical, power, machine, and chemical industries. Industry has become increasingly attracted to transport centers as more distant markets and raw material sources have evolved. Within the Soviet period there has been a trend toward the greater concentration of industry in fewer centers. The structure of industrial production has been transformed from a pre-1917 stress on consumers' goods to a Soviet emphasis on producers' goods.

Industrial location practices in Western Siberia have tended to conform with Soviet planning principles, but the nature and degree of the conformance has varied. Soviet locational planning principles fall into two categories--general principles, influenced by ideological factors, which supposedly direct the broad course of development, and specific industrial location policies which assist in selecting particular places. Some general principles have functioned either to guide or to justify locational decisions, while others have been violated or sacrificed. Decisions on specific industrial locations have generally been consistent with the principles of substitution and comparative advantage.

Industrial development has been responsible for many changes in Western Siberia's geography, largely within the Soviet period. Soviet industrialization has not spurred population growth in Western Siberia, but it has been responsible for a sharp increase in urbanization since 1929. Industrialization has altered the structure of the labor force, influenced developments in transportation and agriculture, and brought periodic reorganizations of the political-administrative divisions.

Western Siberia makes a comparatively small but essential contribution to the nation's industrial production. Of foremost importance are coal, metals, machinery, and power. Western Siberian industry, with a higher than average rate of growth, will probably increase its share of Soviet output from the present 5.5-5.8 percent to 8 percent by 1980. Microfilm $2.75; Xerox $9.00. 198 pages.

AN ANALYSIS OF TERTIARY ACTIVITY AND CONSUMER MOVEMENT: THE SPATIAL STRUCTURE OF LUDHIANA AND JULLUNDUR DISTRICTS, PUNJAB, IN TERMS OF CENTRAL FUNCTIONS AND THE RANGE OF A CENTRAL GOOD.

(Order No. Mic 61-2103)

Robert Charles Mayfield, Ph.D.
University of Washington, 1961

Chairman: Rhoads Murphey

This study examines the spatial structure of two districts of central Punjab, India. Centers offering retail and service activities are considered to be primary units of the structural system.

The initial analysis examines the set of central places for evidence of hierarchical ranking according to the central goods offered. The analysis begins with an enumeration of types and numbers of activities in the centers. An examination of the data is made for evidence of spatially-associated groups of functions. The techniques of cluster analysis are utilized as a relatively simple means of searching for such groups. Twenty-two clusters of central goods are found. Twelve functions prove to be spatially independent. The analysis is continued with a graphic array of points representing population size and number of central function types for the places studied. The Thompson nearest neighbor model is employed to examine the pattern of points for evidence of grouping. Grouping is strongly indicated. A visual inspection of the graphic array suggests that four groups of centers are present in the study area. A linkage analysis confirms the presence of the groups. A more rigorous confirmation of clustering of functions and grouping of centers is provided by the results of an analysis of variance. The conclusion is reached that the centers studied are structured in a hierarchical class-system, based on central functions and population size.

A second empirical analysis is concerned with the patterns of tertiary activity concentration within centers. Cluster analysis is used to identify gross conformations of groups of central functions. One large conformation, containing most of the tertiary activities, is identified as that of the central business district. One small conformation is composed of rurally-oriented activities that seek peripheral urban locations.

A third analysis examines the factors influencing the range of a good. After clusters of factors are determined in an empirical study, comparisons are made with the categories of factors suggested by Christaller. His category, importance of the central place, is recognized in one of the derived clusters. Subjective space preferences of the dispersed consumers supplement the objective counts of central characteristics in forming the cluster. Other groups of range factors include those of costs, occupation and social status, and time and effort.

A final analysis is concerned with the problem of ranking the range factors. Rank is assigned according to the level of significance of each factor in accounting for variations in consumers' trip distances. A standard form of linear multiple regression analysis is employed in the study. Four factors are found to be statistically significant. Elements of cost, relative location, space-preference, and multi-purpose trip type are included. Approximately one-fifth of the variations in consumer trip distances remain unexplained by the model utilized in the analysis.

The study is presented as an illustration of orderly human organization and interaction over a limited time and space. Microfilm $2.75; Xerox $7.40. 157 pages.

ROUTES OVER THE SERRA DO MAR: AN HISTORICAL GEOGRAPHY OF TRANSPORTATION IN THE RIO DE JANEIRO - SÃO PAULO AREA, BRAZIL.

(Order No. Mic 61-581)

Richard Paul Momsen, Jr., Ph.D.
University of Minnesota, 1960

The coastal escarpment, or Serra do Mar, of Brazil has since the first days of European settlement, acted as a barrier to the construction of roads leading inland from the coast and to the development of the country's interior. Its steep slopes, mantled by a dense orographic rainforest, have separated the inhabitants of the highlands from those of the coastal plains. This study deals with the way in which that barrier has been overcome during various stages in the evolution of Brazil's communications, focusing on the area between Rio de Janeiro and São Paulo to illustrate regional differences.

The history of transportation in this region is divided into five periods. The first, lasting from the arrival of the Europeans to 1700, involved the use of existing Indian trails in the area west of Parati (there were no known penetrations of the escarpment behind Rio) and the building of one crude trail between Cubataõ and São Paulo. The second period followed the discovery of gold in Minas Gerais, and from 1700 to 1820 a series of trails were built over the escarpment between Guanabara Bay and the mining areas, while for the first time, Rio and São Paulo were connected by an all-land route.

During the third period, which lasted from the return to Portugal of the Imperial Court in 1821 until 1860, the old trails over the escarpment were improved and many new roads were built in order to handle the rapidly growing flow of coffee from highland centers to the coastal ports, which at last were linked by routes suitable for vehicular traffic. The fourth period, 1861 to 1929, was one of railroad building, accompanied by a decline of the coffee roads to only local importance. Since the depression, the most important advances in Brazilian transportation have involved the building of motor roads, culminating with the Five-Year Highway Plan (1955-1960) of President Kubitschek.

In the concluding chapter, the author shows that throughout these different stages of transport development, the routes over the escarpment have fallen within certain well-defined "route-zones," with minor variations in their trajectories to conform with technological changes. A comparison of these trans-escarpment route-zones shows that the one linking Santos and São Paulo has consistently been more intensively utilized than the others. Although the Rio-Petrópolis zone approaches it in importance, the road building activities of the Guanabara Bay area have been dissipated by the large number of route-zones that have fanned out across the escarpment.

This situation, combined with the topographic advantages of the São Paulo Plateau, have been influential in the development of a highland city at São Paulo, while the port of Rio de Janeiro has remained dominant to the northeast. Parallels are then drawn between the Santos-São Paulo and Angra dos Reis-Barra Mansa and Paranaguá-Curitiba route-zones and urban developments. On the basis of this analysis, a projection is made for the future growth of Governador Valadares, on the Rio Doce route-zone that terminates at Vitória.

Microfilm $5.45; Xerox $19.15. 425 pages.

GEOLOGY OF WALNUT WELLS QUADRANGLE, HIDALGO COUNTY, NEW MEXICO.

(Order No. Mic 61-2206)

Allen M. Alper, Ph.D.
Columbia University, 1961

The Walnut Wells quadrangle is located in Hidalgo County in southwestern New Mexico and lies approximately 60 miles south of Lordsburg and 35 miles southwest of Hachita. It is a 15-minute quadrangle having an area of about 250 square miles and is bounded by the following geographic coordinates: 31° 30' N. Lat. - 31° 45' N. Lat.; and 108° 30' W. Long. - 108° 45' W. Long.

This region lies in the Mexican Highland part of the Basin and Range physiographic province, which is characterized by generally north-south trending dissected fault block mountains separated by alluvial valleys. The Animas Mountains, which traverse the quadrangle, extend northward into the Pyramid Mountains, and southward they split into two ranges and pass into Mexico.

In this region a thick section of pre-Tertiary Sedimentary rocks has been strongly deformed during early periods of orogeny. After erosion, these earlier rocks and structures were covered by a thick blanket of Tertiary volcanic rocks. Subsequent deformation, uplift, and erosional dissection of the Animas Mountain fault block produced the present topography.

Within the quadrangle relative elevation of the mountain block was not great, so that Tertiary volcanic rocks are exposed in over 90% of the bedrock area. Paleozoic and Cretaceous rocks are exposed only in the area south and southeast of Gillespic Mountain, where Tertiary arching and faulting permitted deeper erosion into the stratigraphic succession.

In this area there are Lower and Middle Permian fusulinid limestones and Lower Cretaceous sediments. Approximately 3000 feet of Nuevo Leon, Trinity, and Fredericksburg limestones with interbedded shale and sandstone has been measured, unconformably below 7200 feet of Fredericksburg and Washita orthoquartzites with interbedded sandy shales. Disconformably above is 1000 feet of more of Upper Cretaceous sandstones and limestone conglomerates.

The Tertiary extrusives and intrusives are mostly silicic to intermediate in composition. Three main igneous phases are recognized and subdivided into 11 mappable units: (1) extrusion of quartz latite tuffs 5000 feet thick, and emplacement of two monzonite porphyry bodies; (2) after uplift and erosion, extrusion of hornblende latite and white rhyolite tuffs to a thickness of 1900 feet; (3) after renewed uplift and erosion, extrusion of latite tuff, 1000 feet thick. Probable ages are (1) Miocene to early Pliocene, (2) Pliocene, and (3) Pliocene to post Wisconsin.

A study of the Zircons from the igneous rocks showed that Zircons can be used to characterize and correlate granitic igneous intrusions and extrusions. A study of this type can be useful in tracing igneous bodies and their related ore bodies, and in unfolding periods of complex igneous activity.

Several cycles of deformation are distinguished. Pre-Tertiary rocks were deformed to open, eastward-trending folds. Later, Cretaceous sediments were deformed to tight, northward-trending folds and thrust to the southwest. Tertiary deformation is characterized by normal faulting striking roughly north. Movements along the faults were recurrent, and locally even alluvium was affected.

Manganese, lead, and silver mineral deposits of the quadrangle were investigated.

Microfilm $2.75; Xerox $9.70. 212 pages.

ISOTOPIC GEOCHEMISTRY OF SULFUR

(Order No. Mic 61-2205)

Wayne U. Ault, Ph.D.
Columbia University, 1957

By using dual-collector mass spectrometer techniques a large number of natural sulfur-bearing materials have been analyzed for their S^{32}/S^{34} ratio in an attempt to elucidate further the isotopic geochemistry of sulfur. Careful attention was given to possible fractionation during chemical preparation of the sample. The results are considered accurate to ±.05% of the S^{32}/S^{34} ratio relative to meteoritic sulfur as a standard. The theoretical relationships which may describe isotopic fractionation in natural physical or chemical processes are reviewed.

Various possible mechanisms of natural fractionation were searched for including precipitation of sulfate, crystallization of sulfide minerals (crystal habit, rate of crystallization, temperature, mineral association), diffusion in ore bodies, but all proved negative at the level of ±.05% or ±.01 of the S^{32}/S^{34} ratio. The most significant process that causes sulfur isotopic fractionation is reduction of dissolved sulfate by bacteria. Other observable processes occur in the distillation of volcanic emanations, the oxidation and reduction of H_2S, SO_2 and S at the throats of volcanoes and the reaction of $S^{=}$ - $SO_4^{=}$ under hydrothermal conditions.

After defining the range and average S^{32}/S^{34} ratio of the various sulfur-bearing phases of crust (ocean sulfate 21.76, mafic rocks 22.16, silicic rocks 22.13, hydrothermal sulfides 22.11, sedimentary sulfide 22.37, evaporite sulfate 21.80) an attempt is made at calculating an isotopic material balance. This calculation produces a value for average crustal sulfur which is consistent with the measured ratios for average basaltic rock, average silicic rock and average

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

hydrothermal sulfides. This result points to an average S^{32}/S^{34} ratio for the earth of 22.14 compared with 22.21 for meteorites, thus suggesting appreciable isotopic fractionation during planet formation.

The age effect suggested by Thode is looked for and found absent for at least the last 2×10^9 years.

A comprehensive geochemical theory of the sulfur isotopes can be constructed. Primary earth sulfur (22.14) is brought to the surface of the earth by mafic rock bodies and flows. The sulfur is subject to modification by loss of volatiles which have characteristically light sulfur (22.32) and by contamination through assimilation. Volatiles and extrusive rock sulfur are transitory and by weathering are oxidized and carried to the sea, still with the over-all average terrestrial composition. Reducing bacteria fractionate the dissolved sulfate, generating light H_2S, which forms the metallic sulfides characteristic of shales, and leaving the sulfate reservoir enriched in heavy sulfur. Evaporites formed from the ocean reservoir are isotopically identical with it. Shales are isotopically lighter in sulfur (22.37). Hydrothermal solutions produced at depth in the crust will have sulfur characteristic of the source. The isotopic composition of ore solutions may be uniform if homogenization took place in a magma chamber prior to intrusion, but different from one deposit to the next depending on the relative contribution of shale and sulfate sulfur to the magma. If solutions form by inhomogeneous extraction the sulfur in the ore solution may be heavy or light and may vary during deposition in a given deposit.

It is proposed that the average sulfur isotopic composition of river water is that of average crustal sulfur. If light sulfide and heavy sulfate sulfur are withdrawn from the ocean reservoir at a constant rate, the oceans may well have had a constant sulfur isotopic composition since at least two billion years ago. Fluctuations around this mean as observed in the evaporite deposits may be related to the world-wide competition of bacterial activity, sulfate precipitation and river influx. However, it is most likely that such variations are due to these factors operating in restricted seas.

Special application is made to ore deposits. It appears that the origin of hydrothermal ore solutions is in the crust of the earth rather than the mantle.

Microfilm $3.70; Xerox $12.85. 285 pages.

GEOLOGY OF CENTRAL DOMINICAN REPUBLIC

(Order No. Mic 61-1982)

Carl Otto Bowin, Ph.D.
Princeton University, 1960

The geology of approximately 5,000 square km in central Dominican Republic has been mapped and described.

Metamorphosed, pre-Middle Albian(?), volcanic rocks of the greenschist facies crop out in a belt that trends NW-SE across the mapped area. The metamorphosed rocks occur as two distinct lithologies: metamorphosed mafic volcanic rocks (Duarte formation and unnamed rocks northeast of Jarabacoa); and a unit composed predominantly of metamorphosed quartz keratophyre (Maimon formation). A fault zone containing a large elongate body of serpentinized peridotite separates the two metamorphosed units. At the east end of the Cordillera Central, the trend of the peridotite and of the schistosity in the metamorphic rocks is approximately N. 40 W., but near La Vega in the northwest corner of the area studied, the trend changes to N. 70 W. Unconformably overlying the metamorphosed Duarte formation are vitric basalts of the Siete Cabezas formation, and unconformably overlying the Maimon formation are pyroxene andesite and tuff of the Peravillo formation. The Siete Cabezas and Peravillo formations are pre-Tertiary, and probably also pre-Middle Albian.

The oldest dated rocks are Lower Cretaceous, Middle Aptian-Middle Albian, and occur at the base of the known Cretaceous section. The sequence began with the extrusion of a variety of volcanic types that constitute the Los Ranchos formation. Minor shallow-water sedimentary rocks and radiolarian tuff occur interlayered in the volcanic rocks. Deposition of the Hatillo limestone of Early Cretaceous age followed the eruption of Los Ranchos rocks. Fine tuffs of the Las Lagunas formation (Lower Cretaceous?) were deposited conformably upon the limestone.

Cenomanian to Lower Maestrichtian deposits of coarse tuff, fine tuff, lapilli-tuff, and quartz keratophyre compose the Tireo formation. Uplift and erosion appear to have taken place in Late Campanian to Early Maestrichtian; and middle to late Maestrichtian(?) limestone and clastic deposits of the Las Canas limestone, Don Juan, and other unnamed formations were deposited unconformably upon older rocks. Deposition of the Las Canas limestone (latest Cretaceous) was followed conformably by Paleocene to Middle Eocene wacke, tuff, and algal limestone of the Loma Caballero formation. Early Eocene tuff, mudstone, limestone, and limestone pebble conglomerate of the Los Banitos formation occurs south of the Loma Caballero formation. Deposits of shale, siltstone, sandstone, and limestone were also accumulating in early Eocene time in a basin to the west on the south side of the present Cordillera Central. Eocene volcanism and uplift near central Dominican Republic are in marked contrast to Eocene limestone deposition in the northern and southern portions of the country and in Haiti.

Major faulting and northeastward thrusting occurred in Late Eocene time. Oligocene and younger sections are dominated by clastic sedimentary rocks which fill deep basins north and south of the present Cordillera Central. An episode of deformation in Late Oligocene time affected parts of the Dominican Republic.

Plutons of tonalite (foliated), hornblendite, and augite norite intrude the Duarte formation and are considered pre-Middle Albian(?) in age. The sepentinized peridotite mass appears to have been emplaced following these intrusives, and is also considered to be pre-Middle Albian(?). Unfoliated tonalite plutons (some are batholiths) of Maestrichtian-Middle Eocene age intrude rocks as young as Campanian. Stocks and sills of pyroxene diortie and gabbro were intruded in the Late Eocene.

Microfilm $3.25; Xerox $11.25. 249 pages.

STRUCTURAL DEVELOPMENT OF THE WILLIAMS RANGE THRUST, COLORADO.

(Order No. Mic 61-1407)

John Hall Howard, Ph.D.
Columbia University, 1961

The Williams Range thrust crops out on the west side of Middle Park, Colorado, and the west side of the Williams Fork Mountains, in the south central Rocky Mountains. Field study has been made of an area which includes the central part of the trace. Precambrian and, locally, Jurassic Morrison formation and Cretaceous Dakota formation, thrust onto Cretaceous Pierre principally, mark the trace. The thrust is younger than the Pierre, and study of Cenozoic deposits indicates recurrent fault movement. Direct observation of a cross-section of the thrust surface and other data show that the thrust surface is curved, being nearly horizontal in its westernmost exposures with progressively steeper eastward dips to the east. A sharply overturned syncline lies immediately west of the trace. The axis of a broad syncline parallels the thrust trace on the east; a major high angle fault, which developed contemporaneously with the Williams Range thrust, lies east of this syncline. All east-west cross-sections through the mapped area are similar.

The object of the investigation is to explain the development of the Williams Range thrust surface. Explanations of thrusting in the literature are concerned principally either (1) with the mechanics of movement of a priori freed segments of the crust or (2) with the origin of the surface of faulting. The first category of explanations is not directly applicable, for the main problem of this study is an explanation for development of a fracture which becomes a plane of faulting. For various theoretical reasons and owing to restrictions of certain explanations, of the remaining explanations only those based on stress analysis require further consideration.

A review of theories of failure shows that stress and failure in brittle materials are best related by the Mohr criterion. This criterion states that failure occurs on planes which pass through the intermediate principal stress axis and lie at approximately 30° to the maximum principal stress axis.

Because all east-west cross-sections through the mapped area are similar, an explanation is offered for an "average" cross-section. This cross-section has a minimum of difference with each possible east-west cross-section; the explanation for its development is therefore considered applicable to the entire structure of the mapped area.

Two simple stress systems which predict thrust fault development in a body represented by a rectangle in two-dimensions are those resulting from (1) a supplementary horizontal stress and (2) a vertical step displacement of the lower boundary. Comparison shows that the mapped structure and that produced in model experiments of system (2) agree in all major respects. Comparison also shows that the reconstructed stress trajectories of the average cross-section and the trajectories for a mathematically calculated system (2) are virtually coincident; moreover, this system predicts faulting at locations where faulting has occurred in the mapped area. Comparison with both model experiments and the stress trajectories of a calculated system(1) shows no agreement.

Violation of certain assumptions of elasticity theory are regarded as not sufficiently significant to invalidate the analysis. It is suggested that, on the basis of the uniqueness theorem, an explanation very much different from the vertical step system cannot explain the structural development.

The vertical step displacement system is compatible with the regional structural geology and is geologically practicable. Microfilm $2.75; Xerox $7.40. 157 pages.

THE GEOLOGY OF LEVACK TOWNSHIP

(Order No. Mic 60-5015)

Fred Frazer Langford, Ph.D.
Princeton University, 1960

Levack township lies about 25 miles northwest of Sudbury Ontario, and the Sudbury nickel irruptive passes through its southeast corner.

Consolidated rocks are all Precambrian and the oldest is represented by numerous xenoliths of mafic and biotite gneiss in the quartz diorite of the Levack complex. These inclusions are thought to represent a series of interbedded volcanics and sediments which were subsequently granitized to form the Levack complex. The Cartier granite (formerly Birch lake granite) intrudes the Levack complex with gradational contact. The older quartz diabase dykes occur in great numbers throughout both the Levack complex and Cartier granite and some are porphyritic. The Levack breccia, an intrusive breccia similar to the Sudbury breccia occurs as veins and irregular bodies in the above-mentioned rocks.

The Onaping tuffs of the Whitewater series that occur along the south margin of the map area are andesitic with abundant rhyolite fragments. The steep dips of the gneissosity in the Levack complex and the gentle dip of the tuffs indicate a structural unconformity between these units. The nickel irruptive has been intruded between the Levack complex and Onaping tuffs metamorphosing the latter.

The irruptive has been subdivided into 10 units on the basis of macroscopic evidence. The lowest, the black norite, characteristically contains numerous inclusions. The biotite norite largely consists of hypersthene, possibly a result of crystal settling. Grey norite, characterized by zoned plagioclase laths, is subdivided into a quartz norite and quartz gabbro depending on the chief pyroxene. The transition zone consists of 4 units which are composed of dark transition zone rock and a light transition zone rock which occur in alternate layers. The overlying granophyre is divided on the basis of a slight change from red to greyish red colour.

A lack of both textural and cryptic layering in the norite is not easily reconciled with a change from hypersthene at the base to augite at the top as the chief pyroxene, or with the relative abundance of magnetite and apatite in the transition zone. Modal analysis show a steady increase in the amount of micropegmatite through the transition zone which in thin section seems to be truly transitional in its upper part with the granophyre. The petrology and structure of the irruptive indicate that the main part of the granophyre cannot be derived by differentiation, but that either separate intrusion or assimilation of the rhyolitic portions of the Onaping tuffs are more likely.

Younger olivine diabase dykes cut the irruptive, but cannot be easily traced through the Levack complex.

Pleistocene deposits are mainly glacio-flavial. A boulder zone extending across the northern part of the township is unusual.

In a general discussion of the Sudbury area, opinion is expressed that the folded sediments and volcanics south of Sudbury are Huronian, and thus younger than the xenoliths of the Levack complex. The Sudbury basin is believed to have formed by cauldron subsidence, but by tilting rather than ring faulting. The irruptive is a sill for the most part instead of a fing dyke or true lopolith. The Whitewater series represent the latest Precambrian rocks.

Microfilm $2.75; Xerox $8.80. 194 pages.

PROPOSAL, DEVELOPMENT, AND TESTING OF A SYSTEM OF ANALYTICAL TRIANGULATION FOR MEDIUM-SCALE DIGITAL COMPUTERS.

(Order No. Mic 61-2836)

William Clement Mahoney, Ph.D.
The Ohio State University, 1961

This paper describes the theory and development of a system for numerical aerial triangulation suitable to be performed on a medium capacity computer.

The system as finally evolved was designed for application on an IBM 650 computer and included a method for measuring and reducing coordinate data obtained with a WILD A7; a plane coordinate and a space coordinate system to facilitate analytical extension and adjustment; a continuous computational procedure for numerical aerial triangulation based upon the Herget method; and a method for adjusting strips and blocks of aerial triangulation using point, azimuth, distance, and slope data.

Also described is a test of the developed system that used photography and control data taken over the VERCORS test area in Switzerland. The photography covered an area of 3600 square kilometers at a scale of approximately 1:85000 upon which approximately 315 ground surveyed points could be located and identified.

Four basic experiments were performed to test the finally evolved system. The first experiment was a restrained block assembly and adjustment whereby the block was assembled upon given control. The second experiment was a free assembly of a lattice block made up of alternate strips in the block which was adjusted to control after assembly was completed. The third experiment was a free assembly of all strips of the block which was also adjusted to control after assembly was completed. The fourth and last experiment was the adjustment of the free assembled block in which a minimum amount of fixed control in conjunction with distance, azimuth and slope data was used.

The results of these experiments gave the following standard errors in meters for plan and elevation after final adjustment.

Experiment	Plan σ_p	Elevation σ_z
1	3.42	4.53
2	4.84	4.90
3	5.06	4.65
4	5.79	8.11

It is estimated that the above results stemmed from standard errors of precision of .010 mm in the measurement of photographic coordinates, .025 mm in the identification of the points between strips, and .044 mm in the identification of ground control points. These accuracies are considered comparable with results presently obtained by the best optical mechanical techniques.

It is the over-all conclusion of this study that the analytical triangulation and adjustment system developed is competitive with present instrumental methods both from the point of view of economy and flexibility in meeting a variety of control situations.

Microfilm $4.05; Xerox $14.40. 316 pages.

A STUDY OF THE DISTRIBUTION OF TRACE ELEMENTS IN SOME IGNEOUS ROCKS OF NORTHWESTERN AND CENTRAL ARIZONA

(Order No. Mic 61-2394)

George Wendell Putman, Ph.D.
The Pennsylvania State University, 1961

A study of the nature of trace element distribution within and between igneous plutonic rocks of like and unlike rock type, and of possible regional relationships was made in selected areas of Arizona.

Two hundred and twenty-three rock samples were collected along three roughly linear traverses from seven major intrusive bodies, several smaller plutons and dikes, and from one dominantly migmatitic complex.

The ferromagnesian phases (chiefly biotite) were separated from each sample and analyzed spectrochemically for Pb, Sn, Ga, Ni, Co, Cr, Cu, Zn, Mo, V, and Ag, and by X-ray fluorescence for Ti, Fe, Mn, Ca, K, Cu, and Zn. The bulk-rock samples also were analyzed by X-ray fluorescence for Si, Ti, Fe, Mn, Ca, K, Cu, and Zn.

The analytical results, coupled with petrographic and field data, indicate: (1) the minor-element content of the ferromagnesian phases within a given pluton is relatively uniform, and no systematic trends are apparent; (2) a significant difference exists between plutons with respect to the minor-element content of the ferromagnesian phases; (3) the differences in content of certain minor elements is as great between plutons of like rock type as between different rock types in the range diorite to granite; (4) variations in the content of other minor elements more sensitive to rock type (Zn, Ga, V, Pb) are superimposed on variations between plutons; (5) the Fe/Ti and Fe/Mn ratios in the bulk rock appear to be unaffected by differences in rock types; (6) virtually all the Cu and Zn in the bulk rock are accounted for in the ferromagnesian, oxide, and sulfide phases; (7) areas of known copper mineralization are reflected in anomalously high copper content in the ferromagnesian phases of the associated plutonic bodies. Microfilm $2.75; Xerox $6.80. 142 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

STRATIGRAPHY OF THE OGALLALA GROUP OF A PORTION OF SOUTHWESTERN SOUTH DAKOTA

(Order No. Mic 61-1663)

William David Sevon III, Ph.D.
University of Illinois, 1961

The Ogallala Group consists of fluviatile, late Miocene and Pliocene (Neogene) deposits ranging up to 300 feet in thickness. These deposits extend from Texas to South Dakota in a broad belt several hundred miles wide. The Ogallala sediments were deposited by sediment choked streams, probably at or near grade, which issued from the Rocky Mountain region and filled the valleys present on the pre-Ogallala erosional surface.

Two formations, the Valentine and the Ash Hollow, are recognized in the Ogallala Group in southwestern South Dakota. Each of these formations is correlated with type sections in Nebraska on the basis of lithologic similarity, geologic relations, and characteristic assemblages of fossil vertebrates and plant remains.

The Valentine Formation, the basal unit of the Ogallala Group, was confined entirely to the valleys which had been cut in Arikaree and White River sediments. The pre-Valentine erosional surface sloped to the southeast, and was bounded on the north and west by topographic highs which excluded the Black Hills of South Dakota as a source of sediment. The Valentine is, in general, a non-cemented compact brown to gray fine- to medium-grained arkosic quartzose sand. Calcium carbonate cement, coarser grain sizes, and volcanic ash beds are local variations. The contact of the Valentine and the overlying Ash Hollow is gradational, and the top of the Valentine has been arbitrarily placed at the top of a diatomaceous marl zone from which the majority of the vertebrate fossils were collected. Petrographic studies of 40 samples collected from Valentine and Ash Hollow sediments suggest that more detailed work with the heavy minerals might prove the feasibility of zonation of the Ogallala Group by mineralogic means in local areas.

The Ash Hollow Formation conformably overlies the Valentine, and apparently transgresses the former divides over the valleys in which the Ogallala deposition was initiated. The Ash Hollow is, in general, a calcareous light-gray very fine- to medium-grained arkosic quartzose sandstone. Volcanic ash beds and marls are local variations. Box work structure is developed on most exposed sandstone surfaces. Steep slopes punctuated by sandstone ledges and minor recesses characterize the topography developed by erosion of the Ash Hollow. Several fossil grass seed species are reported from the Ogallala sediments in South Dakota for the first time.

The Sidney and Kimball lithologies have not been recognized in South Dakota as yet.

The Hisle gravel is an early Pliocene channel deposit which was laid down by a rapidly moving stream which originated in the Black Hills and flowed more or less southeastward across the State. The deposits range in size from fine sand to boulders, and are composed of quartz, feldspar, metamorphic rock fragments, chert, and minor amounts of locally derived material. Garnet crystals are abundant in the coarser sand sizes. Sand-calcite crystals are well developed at Snake Butte, and have been attributed to post-depositional cementation by downward percolating calcium carbonate-charged waters. A large number of Vertebrate fossils are present in the deposits.

Ground water, volcanic ash, diatomite, sand, and gravel are deposits of possible economic importance.

Microfilm $2.75; Xerox $5.20. 101 pages.

LITHOSTRATIGRAPHY OF THE MIDDLE ORDOVICIAN SALONA AND COBURN FORMATIONS OF THE TRENTON GROUP IN CENTRAL PENNSYLVANIA

(Order No. Mic 61-2405)

Richard Rogers Thompson, Ph.D.
The Pennsylvania State University, 1961

A lithostratigraphic study was made of the Middle Ordovician Salona and overlying Coburn limestones of the Trenton group in central Pennsylvania in order to contribute to knowledge of the correlations and regional relationships of the formations, as well as to hypothesize their possible depositional environments. The study encompassed foot by foot descriptions of about 20 exposures of the studied rock sequence, and comparative laboratory studies of more than 1,000 fresh and weathered surfaces, 250 etched surfaces, 75 thin sections, 400 insoluble residues and about 15 heavy mineral separations.

The Salona and Coburn formations each have been divided into two members. In ascending order, the Salona includes the New Enterprise member, composed almost entirely of black, variously argillaceous calcilutites, and the Roaring Spring member, characterized by interlayers of laminated and cross-laminated, fine-grained calcarenite. The Coburn includes the Milesburg member, with interlayers of Sowerbyella and Sowerbyella-trilobite bioskeletal calcirudites in alternation with other rock types, and the Coleville member with interlayers of Dalmanella and Dalmanella-crinoidal bioskeletal calcirudites.

Zones of contemporaneity provided by bentonite layers and fossil zones, some newly described, furnish a basis for discussion of the time-space relationships of the rock bodies. The Salona formation is wedge-shaped and thickens toward the southerly and easterly parts of central Pennsylvania as its upper beds replace the lower beds of the Coburn formation at gradually higher levels. Concurrently, the Coburn thins by interfingering with incoming parts of the overlying Antes shale as well as of the Salona formation. The New Enterprise member is a blanket-like deposit over most of the region, whereas other members thicken and thin as do the parent formations. Southward in Franklin County, most parts of the Salona and Coburn formations are replaced by the calcareous shales and argillaceous limestones of the Martinsburg formation. The lower part of the Salona formation is represented there by the thin-bedded calcilutites of the Oranda formation.

The rocks of the Salona and Coburn formations were classed into six lithotypes, namely, bioskeletal calcirudites, calcarenites, calcilutites, calcareous shales, bentonites and dolomitic limestones. The three first-mentioned lithotypes respectively were subdivided into nine sublithotypes on the basis of fossil content, presence or absence

of sedimentary structures and percentage of argillaceous material.

In the Roaring Spring member and in the Coburn formation, most of the lithotypes tend to occur in rhythmic deposits, commonly less than 10 inches thick, that generally begin at the base with an abrupt contact. The contact is overlain by a relatively coarser-grained limestone which grades upward into finer-grained limestones and these in turn into calcareous shale. The rhythmic deposits possibly were formed in an area of shallow water in which the sediments were churned up periodically by storm waves or turbidity currents.

The three major lithofacies bodies recognized in the Salona and Coburn formations correspond to the rocks of the New Enterprise member, the Roaring Spring member and the Coburn formation as a whole. These lithofacies respectively appear to have accumulated in progressively shallower areas with corresponding increases in current strength and improvement of conditions favorable for abundant and varied organisms. They apparently were deposited side by side and acted together as a transgressive sequence during Salona and lower Coburn time, and as a poorly-defined regressive sequence during upper Coburn and lower Antes time.

Microfilm $3.60; Xerox $13.50. 297 pages.

GLAUCONITE IN EARLY TERTIARY SEDIMENTS OF THE GULF COASTAL PROVINCE

(Order No. Mic 61-2131)

Edmund Gerald Wermund, Jr., Ph.D.
Louisiana State University, 1961

Supervisor: Professor Grover E. Murray

Early Tertiary sediments in the Gulf Coastal Province contain numerous glauconitic zones. Studies of the characteristic glauconitic lithologic types in the field and laboratory disclose that they were generally deposited as fossiliferous sands, silts and clays. Secondary textures and minerals indicate that some glauconitic clastic sediments were altered to marlstones and limestones after compaction.

The larger size of glauconite grains relative to associated detritals, the specific gravity, the rarity of broken grains, the organic shapes of pellets, and the altered mud matrices indicate that most glauconite forms early after little or no transportation.

In aggregates of glauconite the sharp contact between pellets and matrix suggests two stages of glauconitization. Multiple stages of glauconitization are also indicated by cryptocrystalline glauconite pellets having ordered glauconitic rims. Micas, feldspars, and quartz replaced by glauconite indicate possibly later glauconitization. Forms resulting from colloidal deposition may have developed at any time during and after sedimentation of the glauconitic beds. All evidence accumulated suggests that glauconitization may occur at different times during petrogenesis.

X-ray analyses performed in connection with this study support Burst's conclusions that glauconite may be iron-rich clays of the mica-, montmorillonite-, kaolin-, or chlorite-types. On the other hand no correlation of glauconitic clay-types with stratigraphic units or depositional environments is apparent.

Total evidence developed from this study suggest that the problem of glauconite genesis will be solved by studying modern sediments.

Microfilm $3.95; Xerox $13.95. 308 pages.

HEALTH SCIENCES, HYGIENE

DRUG SUSCEPTIBILITY OF GEOGRAPHIC STRAINS OF SCHISTOSOMA JAPONICUM

(Order No. Mic 61-1914)

Kuang Yu Chu, Ph.D.
State University of Iowa, 1961

Chairman: Research Associate Professor Hsi Fan Hsü

Forty-six mice were inoculated with 100 cercariae of the Formosan strain of S. japonicum, 71 with the Japanese strain, and 41 with the Philippine strain. They were treated with 125 mg. stibophen per kilogram per day for 21 days. Autopsy of the survival mice (40 with the Formosan strain, 65 with the Japanese strain, and 39 with the Philippine strain) was made six weeks after the completion of the treatment. With the Japanese strain, 96.9 per cent of the survival mice still harboured worms, whereas only 47.5 per cent with the Formosan strain, and 35.9 per cent with the Philippine strain. The mean and standard deviation of the worms found per mouse was 19.3 ± 15.1 for the Japanese strain, 2.2 ± 3.3 for the Formosan strain, and 1.7 ± 4.1 for the Philippine strain.

Sixty mice were inoculated with 100 cercariae of the Formosan strain, 36 with the Japanese strain, and 30 with the Philippine strain. They were treated with 35 mg. tartar emetic and 70 mg. procaine per kilogram per day for 14 days. Autopsy of the survival mice (29 with the Formosan strain, 22 with the Japanese strain, and 17 with the Philippine strain) was made six weeks after the completion of the treatment. With the Japanese strain,

72.7 per cent of the survival mice still harboured worms, whereas with the Formosan strain it was 17.3 per cent, and with the Philippine strain, zero per cent. The mean and standard deviation of the worms per survival mouse was 4.8 ± 5.0 for the Japanese strain, 0.3 ± 0.8 for the Formosan strain, and zero for the Philippine strain.

With both these two antimony compounds, the Japanese strain of S. japonicum is more resistant to the treatment than the Formosan and Philippine strains, whereas the susceptibility of the latter two strains is more or less the same. Statistical analyses of the data confirmed the above conclusion. The fact that there is a difference in drug susceptibility among the geographic strains of S. japonicum is therefore established.

Microfilm $2.75; Xerox $3.00. 33 pages.

HEALTH SCIENCES, PATHOLOGY

BORDETELLA BRONCHISEPTICA INDUCED PORCINE ATROPHIC RHINITIS

(Order No. Mic 61-2467)

Robert Franklin Cross, Ph.D.
Purdue University, 1961

Major Professor: Dr. R. M. Claflin

Porcine atrophic rhinitis was transmitted to three day old pigs by intranasal instillation of crude turbinate material collected from field cases of the disease. The experimental disease was much milder than the naturally occurring disease and no significant deviations from the normal erythrocyte, leucocyte, and differential blood values were demonstrated. Serial transfer of this disease to pigs subjected to temperature stress resulted in rhinitis and death. A bacteria free Selas 015 filtrate of infected turbinate material did not produce the disease. A bacteria free Selas 015 filtrate of virus pneumonia lung did not produce the disease. Intranasal instillation of Microsporum gypseum produced definite but minimal turbinate atrophy. This fungus was not reisolated from the atrophic turbinates.

A bacteria identified as Bordetella bronchiseptica was isolated from the original crude turbinate inoculum, grown in pure culture, used to reproduce the disease in baby pigs and reisolated from those pigs. The severity of the disease produced by this bacterium was increased by severe temperature stress but not by a single mild chill or concurrent infection with pseudorabies virus.

Immunologic studies were made using crude tissue emulsions and cultures of B. bronchiseptica as antigens to test serum samples from the experimental pigs. No significant findings were obtained using plate gel diffusion tests but complement fixing antibodies were demonstrated. These antibodies reacted with ground whole turbinates collected from field cases of atrophic rhinitis, ground whole lung collected from field cases of rhinitis, ground whole turbinates collected from experimental cases of atrophic rhinitis, and a pure culture of B. bronchiseptica. B. bronchiseptica was present in all three tissue antigens. Only serum from infected pigs contained these antibodies. No antibodies were demonstrated in serum from the uninoculated control pigs, the transmission failures, or the pigs with turbinate atrophy induced by M. gypseum.

In a survey to determine the incidence of a complement augmenting factor in swine serum it was found that 89.5% of 200 random swine serum samples showed procomplementary activity and 0.5% were anticomplementary. This procomplementary activity was removed by phenolization of the serum to 0.5% with a 5% aqueous phenol solution. Serum phenolized to 0.25% retained some of its procomplementary activity and the same serum phenolized to 1% was anticomplementary. Saline phenolized to 0.5% had no effect on the activity of the complement.

The bacterium identified as B. bronchiseptica was defined by its colonial and individual morphology, its biochemical reactions and pathogenicity, its resistance to antibiotics, freezing and drying. Fresh cultures were found capable of elaborating a toxic material which caused hemorrhage and death when injected intradermally into suckling mice. This bacterium was isolated from the ethymoid turbinates of nine out of ten cultured cases of active atrophic rhinitis submitted to the Animal Disease Diagnostic Laboratory at Purdue.

Microfilm $2.75; Xerox $5.40. 109 pages.

HEALTH SCIENCES, PUBLIC HEALTH

A STUDY OF COAL DUST CONTROL IN POWER PLANTS

(Order No. Mic 61-1875)

Cornelius Wolfram Krusé, Ph.D.
University of Pittsburgh, 1961

The trend toward greatly increased generating capacities for the modern power plant utilizing solid fuel suggest that environmental dustiness in the coal handling may constitute a potential pneumoconiosis hazard to power plant workers. The problem of assessing the degree of hazard is made uncertain by the status of opinion regarding the tolerance limits for breathing bituminous coal dust that is low in "free silica."

The study comprises a field survey of prevailing dust concentration at the work stations along the coal handling and storage systems of seven modern generating plants. The source, concentration, and the character of the coal dust is determined. Factors influencing the dust size, dispersion, and concentration are examined in detail. Among the important factors affecting the dustiness are the moisture content of the coal, induced air flow within the chute systems, prevailing winds, rain, and method of housekeeping.

The discovery of the strong influence of coal moisture on atmospheric dust concentration in power plants led to the development of a procedure for forecasting the average dust exposure to workers from existing records on the moisture content of coal handled. Concentrations of dust so estimated compare favorably with those determined from the average of full shift dust sampling.

The health hazard resulting from power plant dust exposure is synthesized from the review of epidemiological experience in the coal mining industry. These data are assumed to be appropriate after study of dust composition and size and by the reconciliation of differences in measuring atmospheric concentrations. An estimate of disease risk to workers is made assuming the maintenance of existing levels of dust exposure in plants studied. It is concluded that the risk of anthracosilicosis is slight but that about 26 per cent of the workers exposed may be expected to reach the category of simple pneumoconiosis within a working lifetime which, upon subsequent bacterial infection, may subject them to considerable risk of disease and disability.

The dust control methods currently employed in power plants are evaluated. Controlled wetting of coal handled proved to be of a greater benefit in dust suppression than that afforded by the collision of water droplets with airborne dust. Dust dispersion resulting from air induced by the flow of coal through inclined chutes is identified, measured, and compared with theoretical equations developed for "free falling" materials. From the field data collected an efficiency factor is empirically developed which when properly applied may predict the rate of air induction created by material running through enclosed inclined chutes. The developed expression is useful in the design of conveyor systems and in determining the necessary rate of exhaust for overcoming the dust dispersion in chutes.

Recommendations are given concerning the intensification and strengthening of dust control in power plants. These include suggestions for the improvement of methods at the rotary car dumper, conveyor system, in the design and operation of local exhaust at transfer points, and controlling dustiness on the haulways in the coal storage yard. A suggested program of environmental and medical surveillance is outlined.

Microfilm $2.75; Xerox $7.60. 164 pages.

HISTORY, GENERAL

SAMUEL I. ROSENMAN: HIS PUBLIC CAREER.

(Order No. Mic 61-1490)

Samuel Burton Hand, Ph.D.
Syracuse University, 1960

Supervisor: O. T. Barck

The career of Samuel I. Rosenman surpasses in significance even that of being one of Franklin D. Roosevelt's most influential and durable advisers. Despite this, historical references to him are usually confined to accounts of Roosevelt's speechwriting activities. This study is an attempt at a more complete discussion of Samuel Rosenman's contributions to the history of New York State and of the nation.

As a young Manhattan Assemblyman during Alfred E. Smith's administrations as Governor of New York, Rosenman was an active proponent of increased social welfare legislation. In a subsequent post as Bill Drafting Commissioner, he demonstrated such a thorough comprehension of and sympathy with the Smith program that he was assigned in 1928 to gubernatorial candidate Franklin D. Roosevelt's campaign staff as the expert on state legislative affairs.

Their association, both personal and official, was a long and fruitful one terminated only by Roosevelt's death. As Counsel to the Governor, Rosenman provided the technical skills which enabled Roosevelt to maintain and expand the Smith legislative program without having to utilize front rank Smith aides. This in turn enabled Roosevelt to develop an executive image undominated by the figure of the Happy Warrior -- a condition essential to the emergence of Roosevelt as the leading Democratic candidate for the 1932 presidential nomination.

Early in 1932, Rosenman left the Governor's official service to assume office as a justice of the New York State Supreme Court, a position which, except for some months during 1933, he held for over eleven years. During that entire period he maintained an active interest in the Roosevelt political fortunes. His efforts in the creation of the brain trust and his contributions to the President's public papers have become almost legend; his assistance in administrative affairs has so far received less attention.

Throughout the period of United States preparation for World War II, as well as during its involvement in the struggle, the Judge was a major force in the creation and reorganization of national defense agencies. He strove to help mold a bureaucracy capable of coping with wartime problems without having to resort to serious curtailment of New Deal legislation. Late in 1943, he resigned his judicial office to become presidential counsel so that he might devote his full energies to problems arising from the war.

Within days after the death of Franklin D. Roosevelt, Rosenman presented his resignation to Truman. Rather than act upon it immediately, however, the new President instructed his inherited Counsel to complete the assignments upon which he was then engaged -- a survey of economic conditions in western Europe and negotiations for international trials of captured Nazi leaders.

After the completion of these projects, President Truman insisted that Rosenman remain as Counsel. During this period Rosenman's service to Truman is strikingly analogous to his service as aide to Governor Franklin Roosevelt He provided a vital link between the administrations of two outwardly diverse personalities which contributed immeasurably to the continuity of their programs.

In February, 1946, Rosenman resigned his position as

Counsel to the President in order to enter into the private practice of law. By this time he possessed the distinction of being the very last of the New Deal inner circle to hold office under Harry Truman.

Microfilm $3.70; Xerox $13.05. 286 pages.

A HISTORICAL STUDY OF THE DEVELOPMENT OF AMERICAN MOTION PICTURE CONTENT AND TECHNIQUES PRIOR TO 1904

(Order No. Mic 61-2538)

Richard Arlo Sanderson, Ph.D.
University of Southern California, 1961

Chairman: Professor MacCann

A sample of 681 films which had not been previously released for study were viewed and analyzed in order to trace the development of film content and film techniques in the first motion pictures produced in America. These films were selected from a collection of paper prints submitted to the Library of Congress for purposes of copyright between 1894 and 1913.

Questions asked during the investigation were: (1) What types of films and what subject matter appeared to predominate and were any trends evident? (2) When did special film techniques begin to develop and how were they used? (3) What relationship existed between film types, film subjects, and film techniques?

A majority of the films studied represented a documentary approach or a tendency toward topical films and "actualities." The four prominent categories under film type were documentary, travelogue, entertainment, and sports. Trends in the types of films revealed a predominance of news films during 1898, 1899, and 1900. In 1901 travelogues showing national and international scenes became prominent.

Four film subjects ranked highest in occurrence with a margin of at least twice as many listings as any of the other subject categories. These four were scenic and travel, transportation, recreation and entertainment, and military. The only obvious trend in the choice of subject matter was a natural concentration on the Spanish-American War in 1898 and 1899.

The analysis of film techniques was divided into three main sections—camera movement, special effects, and film composition. The first movements of the camera appeared to develop as a result of necessity. For example, the first panning movement in 1898 was a follow action shot which developed out of attempts to keep a charging bull in the camera's field of view; the camera tilt first appeared in 1900 as a means of photographing the vertical height of a tower. Trucking and dollying movements were observed in films produced in 1898. These films seemed to reflect a desire to place the camera in motion and include larger fields of view by photographing from moving boats and trains.

Only one dissolve was found among the films studied, but four films between 1901 and 1903 contained fades. Stop motion and other trick camera effects were used in twelve films with the first two appearing in 1900. The fact that no development of these techniques was observed before the rather complex use of them apparent in 1900 suggested that the effects developed by Melies in France were copied to a great extent by American film producers.

The use of special techniques in film composition was concentrated in news and sports films. This concentration seemed to indicate that such techniques were advanced most in situations in which the subject could not be controlled, making it necessary to establish a control of the camera by moving it and taking shots at various angles and at various distances from the subject.

Recommendations for further study of the collection of films copyrighted between 1894 and 1913 included a complete identification of individual subjects revealed in the films, a study relating the development of the motion picture industry to the content of these films, and a sociological study to determine the effect which the American society at the turn of the century had upon the content and treatment of content in these early films.

Microfilm $3.25; Xerox $11.50. 251 pages.

HISTORY, ANCIENT

ASSYRIAN COLONIES IN CAPPADOCIA

(Order No. Mic 60-6916)

Louis Lawrence Orlin, Ph.D.
University of Michigan, 1960

The purpose of this study is to analyze the political relationships existing between the Old Assyrian traders and their kârum and wabârtum organizations of Anatolia (ca. 1900-1780 B.C.), and the indigenous administrations of the Anatolian cities wherein they traded, so as to arrive at a definition of Assyrian colonization during this period. The importance of such an analysis is manifest (a) because of the continuing sharp and uncompromising disagreement between those who believe that the Assyrian colonies were founded as a result of an Old Assyrian conquest of Anatolia (hence the Assyrians were overlords of the indigenous princes) and those who deny that Assyria exercised any such political domination during this period, (b) because no single school of interpretation is internally consistent in its views, and (c) because the recovery of new Cappadocian tablets at Kültepe necessitates continual reappraisal of the problem.

In Part I of the study, a general view of the distribution of the Assyrian colonies, their trading activities and their position within the Old Assyrian political structure is presented. The colonies are seen to be tightly organized, in close communication with each other and with Kârum Kaniš, which, for its part, acted as administrative executive for all. The internal activities of the colonies are regulated by Assyrian law as issued from Assur. The traders, themselves, represent a homogeneous Semitic group within the Anatolian ethnic milieu, and they strive to maintain cultural self-identity through close observance of Assyrian customs.

In Part II of this study, the relations between the Assyrian settlements and the Anatolian princes are treated. From a critical study of the Cappadocian tablets, a listing

of the cities having indigenous administrations is given. Many princes are seen to rule in places where Assyrian kârû or wabârâtum are located, and this allows a comprehensive examination of political contacts between their administrations and the colonies. Relationships are shown to be based upon oaths which in no way demonstrate Assyrian political superiority, but which strongly suggest (although in the absence of any actual treaty-documents) that Assyrians and Anatolians negotiate on a parity basis. This is supported by an analysis of many instances which show individual Anatolian princes acting toward the Assyrians in ways which clearly speak to their autonomy. The Anatolian principalities can maintain armies, fight petty wars with each other, and even control their own networks of vassals, at a time when the Assyrians are alleged by some to have exercised political and military domination in Anatolia.

Two general conclusions can be drawn from the study. (1) Although no documents tell us anything of how the colonies were founded, analysis of the political evidence in our sources strongly suggests that force did not play a part, and that the Assyrians gained residence quarters in Anatolian cities because of their status as merchants. They were able to create an economic "empire," at once providing Assyria with a foreign market and exploitation area, and incidentally stimulating Anatolian economic development in the decades preceding the rise of the Old Hittite Kingdom. (2) The Assyrian colonies, although widely distributed in Anatolia, and administratively dependent upon Assur, represent a "community"--an ethnic, cultural and economic, but not political, extension of Assyria. As such they are internally governed by Assyrian law. But they maintain symbiotic relationships with the many and heterogenous Anatolian "communities." Such relationships reflect Assyrian financial and commercial domination, but not the pre-eminence of Assyrian sovereignty in Anatolia.

Microfilm $4.15; Xerox $14.65. 321 pages.

A LEASE OF AN OLIVE GROVE FROM THE ARCHIVE OF AURELIUS ISIDORUS (P. COL., INV. NO. 65).

(Order No. Mic 61-2221)

Sarah Berman Porges, Ph.D.
Columbia University, 1961

P. Col., Inv. No 65 (Karanis, 300 A.D.), which is published now for the first time, is a lease of an olive grove in the form of a hypomnema addressed by Aurelius Isidorus to Aurelia Thermoutharion. The duration of the lease is five years; the size of the property is two arouras; and the rent paid for it is one artab of olives yearly plus half the produce. The lessee does all the agricultural chores, the lessor is responsible for all the public charges. P. Col., Inv. No. 65 is the only published lease of an olive grove in which all the essential parts of a lease -- the names of lessor and lessee; the size, location, and type of land; the rent; the duties of lessor and lessee; and the date and duration of the contract -- are preserved. The present document is the only published lease of an olive grove which can be dated later than the second century A.D.

P. Col., Inv. No. 65 is of special interest since it contains two words -- xerologia and kormologia -- which have appeared only once before, and one new word -- periskalismos (in the accusative case).

The lease is thirty-four lines long, and is written in a regular early Byzantine cursive script.

Microfilm $2.75; Xerox $3.00. 42 pages.

HISTORY, MODERN

ENLIGHTENMENT CHURCH HISTORY IN THE UNITED STATES, 1800-1850.

(Order No. Mic 61-2024)

Robert Rugh Clemmer, Ph.D.
University of Pennsylvania, 1961

Supervisor: Roy F. Nichols

This is an examination and interpretation of American Protestant thought in the first half of the nineteenth century from the perspective of the conception of history inherent in Enlightenment philosophy and Evangelical piety, and an account of Enlightenment historiography in church history in Europe and America. An attempt is made to understand the attitude toward history which existed in American Protestantism in that era, to discover the European works which were principally relied upon to provide historical information, and to view the emergence of ecclesiastical historiography in America in the light of both the American intellectual climate and the European sources and models.

The approach to the problem was by way of the quarterly theological journals published by the principal denominations. In the historical articles which appeared in their pages the chief teachers and writers of church history in the nation's seminaries and colleges were discovered. Investigation of the careers and writings of those scholars brought to light most of the American productions in the field of church history. The quarterly journals also supplied valuable information with regard to the acquaintance with and reception of European works in the United States.

American Protestants in the first half of the nineteenth century knew little of the history of the Christian church. The sources of this unhistorical perspective are to be found in environmental factors, both material and intellectual, and in the structure, thought, and piety of American Protestantism itself. Denominationalism tended to restrict historical interest within sectarian bounds while a unity of ethos focused attention upon British Puritans and Presbyterians and their American descendants. The major features of the dominant theological outlook were also uncongenial to an historical orientation: biblicism, scholasticism, and a static propositional theory of truth derived from Scottish Common Sense philosophy. And, finally, evangelical piety--with its existential experience of the "New Birth" and its spiritualistic and activistic understanding of the "New Man"--created obstacles to the growth of historical interest and understanding.

Ecclesiastical historiography in Europe passed through

three major phases: orthodox, pietistic, and pragmatic. Protestant church history began in Germany and the general account most widely used in the United States before the Civil War was that of the German pragmatic historian, Mosheim. The major English contribution to church history appeared in the orthodox period: Foxe's Book of Martyrs and the patristic works of Pearson, Cave, Bull, et al. The general history of the Anglican pietist historians, Joseph and Isaac Milner, and the works of the pragmatic historians, Hume, Robertson, and Gibbon, were widely read in this country. The writing of church history on the continent of Europe outside Germany was dominated by French Reformed scholars, and the works of several French Roman Catholic historians were frequently utilized by Protestants. American church historians in the tradition of the Enlightenment were familiar with the whole range of this European literature written in Latin.

Enlightenment church history in the United States was polemical in form, utilitarian in purpose, and was dependent upon European historical scholarship. No native-born American in the first half of the nineteenth century possessed enough self-confidence to write a general church history; in this area of its intellectual life the United States remained provincial until after the Civil War. However, despite this fact, there were a number of American church historians who were capable and relatively well informed: James Murdock, John Bowden, Samuel Miller, Alvan Lamson, Hosea Ballou, William White, and John Henry Hopkins. American students and writers of church history were interested primarily in the early church; the middle ages were deemed unworthy of investigation and even the Reformation received relatively little attention.

Microfilm $4.25; Xerox $15.10. 332 pages.

CIVIL WAR ISSUES IN PHILADELPHIA, 1856-1865.

(Order No. Mic 61-2209)

William Warner Dusinberre, Ph.D.
Columbia University, 1960

The essay explores general political issues of the Civil War era by concentrating upon a single northern city. Political attitudes in Philadelphia were probably rather similar to those in certain other regions of the Middle States, such as New York City, much of New Jersey, and southern and central Pennsylvania, Ohio, Indiana, and Illinois. Two features of the situation in Philadelphia are emphasized: the persistently anti-Negro and frequently pro-southern attitude of the Democratic Party; and the constant appeal of leaders of the anti-Democratic party to considerations of political power and security rather than to motives either humanitarian or economic.

Democratic politicians grossly exaggerated the prevalence of abolitionism, and many party leaders justified southern secession as a defense against the exaggerated dangers of a Republican electoral triumph. Most Philadelphia Democratic leaders adopted a proslavery position during the territorial slavery controversy of 1857-1858. Most anti-Democrats were aroused, not so much by slavery itself, as by the actions of southerners and their northern allies attempting to perpetuate the institution.

Those few Philadelphians who were abolitionists helped approximately 1100 fugitive slaves to flee northward from 1853 to 1860. (Government officials, however, usually enforced the fugitive slave law conscientiously whenever a claimant succeeded in locating a fugitive in eastern Pennsylvania.) Although the underground railroad was especially active during the years from 1855 to 1858, the abolitionist movement as a whole was of declining vigor in Philadelphia during that period. John Brown's raid and its consequences increased the vote for the Democratic Party, but also stimulated the abolitionist movement and strengthened the antislavery convictions of certain conservatives who regarded the raid itself as an odious crime.

In March 1861, when Lincoln seemed about to abandon the southern forts to the seceding states, all Philadelphia newspaper editors acquiesced in his supposed plan. They were so reluctant to do so, however, that when the contrary policy was adopted, nearly all of them quickly reversed themselves and endorsed the forthcoming war, citing as the most persuasive reason that disunion would imperil the military security of the North.

When emancipation measures were adopted in 1862, anti-Democratic leaders justified them on military rather than humanitarian grounds. Democratic leaders Unanimously denounced the new measures. The Democratic program of repealing the emancipation proclamation was the major issue in the wartime elections of 1863 and 1864; the differences between the two parties in those years were much more important than the factional divisions within each party.

Only five Philadelphians arbitrarily arrested for political reasons during the war were imprisoned for more than a few days. After a vigorous Democratic protest against the temporary suppression of their newspaper (in January 1863), an astonishing degree of free speech prevailed in the city.

On the three occasions when Confederate troops invaded, or threatened to invade, Pennsylvania, the response of the Philadelphia militia was slow, chaotic, and usually inadequate to the demands of the President or the governor. Opposition to the administration's conduct of the war played a large part in discouraging volunteering. The absence of draft rioting in Philadelphia was attributable, not to Democratic enthusiasm for the war, but to firm and impartial action by the commanding general and the mayor.

The emancipation of southern slaves encouraged a movement to raise the status of free Negroes in Philadelphia. The ban against Negroes in Pennsylvania's military units was lifted, however, only by federal intervention, and the movement to end segregation in public streetcars was abortive until the Reconstruction period.

Microfilm $4.50; Xerox $16.00. 351 pages.

REVIVALISM IN THE GERMAN REFORMED CHURCH IN AMERICA TO 1850, WITH EMPHASIS ON THE EASTERN SYNOD.

(Order No. Mic 61-2031)

John B. Frantz, Ph.D.
University of Pennsylvania, 1961

Supervisor: Professor Wallace E. Davies

The objective of this study is to trace the course of revivalism into and out of one specific denomination, the German Reformed Church. This denomination readily lends itself to such a study, for its constituency was comparatively homogenous racially, socially, and theologically, making it possible to isolate the issues involved in the question of revivalism to a degree not possible in other, larger religious bodies.

With this objective in mind, a vast body of material was examined, including denominational periodicals, records of the administrative units of the Church, congregational records, contemporary books, pamphlets, sermons, addresses, diaries, journals, and the less plentiful and less accessible remnants of contemporary personal correspondence. This evidence tends to suggest certain definite conclusions.

The tendency of the revivalism in the German Reformed Church during the Great Awakening in the early 1740's and during the Second Awakening of the early 1800's was schismatic, resulting in the exodus of the revivalists from the German Reformed Church. With those of other denominations who were similarly inclined, they joined the Moravian Church, the Church of the United Brethren in Christ, the Evangelical Association, and the Church of God. Following the secession of these elements, the trend toward revivalism in the Church was checked temporarily.

However, in the third and fourth decades of the nineteenth century the Charles G. Finney brand of revivalism swept into the Church spreading new measures such as protracted meetings, anxious meetings, and the anxious bench in its wake. During the 1830's and the early 1840's emotional revivalism with its emphasis on sudden, climactic conversion threatened to become dominant over the traditional German Reformed concept of an educational religion based upon regular pastoral training of the youth in the doctrines of the Heidelberg Catechism through instruction in catechetical classes.

The extent to which new measures were adopted within the Church depended on the density of the German-speaking population in a specific region. Where they were heavily outnumbered by members of the English churches, such as in the city of Philadelphia and the state of North Carolina, the German Reformed were anxious to adopt the new measures which were in style among many of their ecclesiastical neighbors. On the other hand, the heavily German regions, such as the Allentown-Bethlehem-Easton area of Pennsylvania, where the use of the German language had been retained in the Church, vigorously opposed the introduction of new measures and for cultural and theological reasons, they urged the German Reformed to persevere in the traditional ways of their Church.

It was the leadership of John W. Nevin, Professor of Theology in the German Reformed Seminary at Mercersburg, Pennsylvania, which enabled this faction of the Church to prevail against the rising tide of revivalism. In 1843 Nevin wrote The Anxious Bench: A Tract for the Times, wherein he attempted to discredit the use of new measures by demonstrating that they placed too great an emphasis on the role of man in salvation and not enough emphasis on the role of God. In this and subsequent writings Nevin discussed the Church as the mediator of Christian salvation and encouraged the German Reformed to place increased importance upon its rites and sacraments. Although the Church at large hesitated to assume the "high church" position which Nevin advocated, the eastern portion of the Church did follow his lead in rejecting the current revivalism, characterized by the use of the anxious bench, and returned to its heritage, symbolized by the use of the Heidelberg Catechism in its traditional catechetical system. Microfilm $4.05; Xerox $14.20. 314 pages.

FIFTY YEARS OF EVANGELICAL MISSIONARY MOVEMENT IN NORTH AFRICA, 1881-1931.

(Order No. Mic 60-6771)

Willy Normann Heggoy, Ph.D.
The Hartford Seminary Foundation, 1960

The aim of this thesis is to trace the history of the first fifty years of Protestant missions in North Africa with special reference to Muslims. Begun in Algeria in 1881, the endeavor spread to Morocco in 1884, to Tunisia in 1885, and to the country which is now Libya in 1889. These four countries from a geographical unit which historically has been called al-Maghrib by the Arabs and Barbary by Western writers.

The historical part is composed of four chapters. The first covers the period 1881-1884 and shows how the denominational missionary societies by-passed North Africa, and how a small group of English Christians, on the fringes of the organized churches, took up the challenge.

Chapter II deals with the period 1884-1895, and in particular with the establishment of fragmentary groups from Morocco to Tripolitania (Libya). Of special interest was an experiment in apostolic missions launched by an American, E. F. Baldwin, and based on Baldwin's interpretation of Matthew X. The experiment ended in 1890.

Chapter III continues the exposition up to 1907, showing how Protestant missions took root despite opposition from French, Turkish, and Moroccan authorities. Special attention is given to the attitude of French authorities. The initial opposition was later changed to more favorable sentiments. The experiment of an early missionary, Emma Herdman, is described. She had succeeded in training converts from Islam and in sending them out as self-supporting colporteur-evangelists.

In Chapter IV, covering the period 1907-1931, is related the coming of the Methodist Episcopal Church under the leadership of Bishop Joseph C. Hartzell. This event is linked with the World Sunday School movement. The Methodist Mission is seen in its relation to the faith missions already in North Africa. The missionary situation in 1931 is surveyed.

The last two chapters include a discussion of the principles of the several missionary organizations.

The missions before 1907, with few exceptions, were undenominational faith missions, laymen's movements with a strong emphasis on subjective religion, and minimizing teachings concerning the Church and the Sacraments. The Methodist Mission came in 1908 as a Church, with an emphasis on cooperation and consolidation. This emphasis is further demonstrated in an analysis of the general missionary occupation of North Africa. The Methodist Mission established stations with all-inclusive programs designed to reach all categories of people and influence society as a whole. Some stations of the faith missions also were well developed, but most of them were mere evangelizing posts occupied by one or two missionaries, several occupied by women only. Twenty-five of these posts have been abandoned, showing a lack of permanency. The purpose and aim of missions to Muslims are discussed, and the methods used in North Africa have been considered. There is also a discussion of the missionary message.

In conclusion, a missionary program is suggested. The program envisages a Church in which the weekly Communion service is equal in importance to preaching, in which baptism is more than a public demonstration, which has in the early stages no other hierarchy than laymen set aside to administer the sacraments, and which is composed of informal groups of Christians meeting as the Body of Christ in the Muslim world.

The sources used in this study are missionary periodicals, annual reports of the various organizations, published and unpublished biographies and memoirs, the histories of several societies, and the archives of mission boards as well as private archives. This source material is in English, French, Swedish, Danish, and German.

Microfilm $5.15; Xerox $18.25. 401 pages.

THE PUBLIC LIFE OF CORDELL HULL: 1907-1924.

(Order No. Mic 60-2731)

Cooper Milner, Ph.D.
Vanderbilt University, 1960

Supervisor: Professor Dewey W. Grantham, Jr.

This study proposes to identify some of the features of the political process to which Cordell Hull contributed and which in turn may have shaped his career as a Congressman and Secretary of State. A particular aim is to evaluate Hull's contribution to the fiscal legislation of Wilson's administration, in the writing of which he has hitherto been credited with only a minor role. The papers of Hull, Woodrow Wilson, William E. Borah, Claude Kitchin, Thomas J. Walsh, and others have been examined for that purpose and also to sample other Congressional viewpoints.

Born in the hill country of East Tennessee, Cordell Hull was elected to the Tennessee legislature when not quite twenty-one, was a Tennessee circuit judge, and served in the United States House of Representatives and Senate for all but two years in the period between 1907 and 1933.

He thought of himself as a disciple of Thomas Jefferson and Andrew Jackson and as a Gladstone liberal who, in the opening decades of the twentieth century, found the older theories of laissez-faire inadequate to curb the growth of corporate monopoly. He supported the economic reforms of the New Freedom because he hoped that limited governmental action would eliminate those obstacles to a natural economic order which special privilege had earlier written into law. If this were done, he believed, the automatic equilibrium of the economic system would operate once again to maintain conditions of free competition. In most respects a strong advocate of state rights, he refused until 1916 to endorse child labor legislation and he opposed woman suffrage until 1919.

Hull specialized in tax and tariff legislation to the exclusion of almost every other interest, pressing through to completion the income tax of 1913 and the estate tax of 1916. He was wartime chairman of the Board of Excess Profits Tax Advisers, a group charged with interpreting for the Internal Revenue Service much of the fiscal legislation of World War I. Hull was consulted frequently by the Treasury Department on fiscal policy during the war. His role in the Wilson administration was that of a moderate progressive who attempted to maintain a balance between the more radical agrarians and the economic Bourbons of his party.

A party regular throughout his Congressional service, he became chairman of the Democratic National Committee in 1921 and for nearly three years worked to transform a deeply divided party into an effective political organization. Hull's correspondence with Franklin D. Roosevelt, Louis M. Howe, Bernard Baruch, and Norman Davis indicates his attempt to achieve the co-operation of moderates and conservatives in preparation for the Presidential elections of 1928 and 1932. He demonstrated an astute, practical knowledge of the political process at different levels of government which, coupled with a cautiousness and a conservatism that became more evident in the middle twenties, helped to make him a key figure in the upper ranks of his party.

As early as 1924 he challenged the claim that the protective tariff was the chief factor in American prosperity. He argued that low tariffs, combined with the enterprise of the American people, would make this country "the center of both the finance and the commerce of the world." In 1916 he recommended a postwar international economic congress to plan for the elimination of cartels and other obstacles to trade which, he contended, led to economic and military warfare. From this time he continually urged the adoption of unconditional most-favored-nation and other trade agreements as essential to the promotion of a stable, international economic system, and became the recognized authority within his party on tariff and fiscal problems.

Although his hopes for high national office in 1928 and 1932 failed, his appointment as Secretary of State in 1933 brought the opportunity to work for world peace through international economic agreements.

Microfilm $6.20; Xerox $22.05. 486 pages.

FRENCH POLICY IN RUSSIA: 1755-1762.

(Order No. Mic 61-1497)

Lawrence Jay Oliva, Ph.D.
Syracuse University, 1960

Supervisor: Warren B. Walsh

An understanding of French policy in Russia during the Seven Years War has been obscured by lack of research and by restricted perspective. The French historians who have shaped its interpretation were pleading for the wisdom of the Franco-Russian alliance of 1890-94. Supporting their contention that France could be safe against Germany with Russian aid, these historians insisted that the failure of the Franco-Russian alliance of 1755-1762 was an unfortunate French error.

To maintain that this alliance of the Seven Years War could have been valuable, it must be shown to have had qualities of mutuality and durability. This study analyses the origins, content, character, and results of that alliance in order to discover whether such qualities were present.

The Franco-Russian alliance, 1755-1762, was a hastily created by-product of the Diplomatic Revolution. France entered a continental war in which it had no interest. To wage this war, France allied quickly and haphazardly with Russia. At the outset, France and Russia agreed only on the necessity of waging the war. Beneath this superficial agreement were serious disagreements about the war's purposes. Russia was fighting for territorial gain; the French merely to fulfill their obligations to Austria. France was interested in the English war and wished a quick end to the Prussian war, leaving Prussia a strong factor in Europe. France and Russia seriously disagreed on war aims.

France entered the Russian alliance with no determination to create an enduring union. This was realistic. Russia was aware of its own interests, and determined to carry on the war to a rewarding victory. It was France which, weakened by defeats, found the tables turned and was used as an instrument by Russia for Russian aims.

Because of these emerging disagreements, trust between France and Russia was non-existent. The two came to no agreements on eastern Europe. France, forced by bankruptcy and defeat, pulled back from Poland, and Russia moved quickly into the vacuum. France could exact no payments for Russian gains.

France weakened in the double war and sought peace. Here again French and Russian interests clashed. It was reasonable for France to seek an immediate peace in Europe; it was equally reasonable for Russia to insist on waging the war to a rewarding conclusion. Russia would deliver no continental peace to France. The ensuing attempt of France to gain Russian military aid against England was foolish. Russia had no interests in an English war.

Further, there was no indication of durability in the alliance. The Young Court of Russia was an enemy of France. The approaching power of these Imperial heirs threatened the future. Neither the Young Court nor the French Ministry saw any promise in the alliance. Commercial ties between France and Russia, upon which future cooperation might have been based, were not developed. Russian trade was firmly in English hands. French and Russian indifference made commercial ties impossible.

France should not have joined the continental war, nor should there have been a Russian alliance. France had entrapped itself and could not escape without serious injury. The keynote of the alliance, therefore, was inherent conflict of national interests. Beneath the original intent to wage war, France and Russia disagreed on war aims, the necessity of peace, the building of commerce and the future of eastern Europe. The union of France and Russia was less an alliance than a contest to determine who could make best use of whom. In this contest, France was the loser. Microfilm $5.25; Xerox $18.70. 411 pages.

BAPTISTA MANTUANUS-CARMELITE HUMANIST.

(Order No. Mic 61-2287)

William Ernest Painter, Ph.D.
University of Missouri, 1961

Supervisor: Lewis W. Spitz

The primary purpose of this dissertation is to make a study of the character of Renaissance thought with emphasis upon its religiosity by presenting the life and works of one of the leading humanist figures, Baptista Mantuanus. Baptista's life as a Carmelite monk and a prominent leader of that Order combined with his prolific output of some 55,000 stanzas of humanist verse offers an excellent opportunity to examine the relationship of religion and humanism.

The problem of the Renaissance remains controversial and intriguing. Baptista, as a Renaissance figure, stands much closer to the Tofannin concept than to the Burckhardtian in his career and in his religious and philosophic outlook. Despite this, a consistent criticism of the Church and an unrelenting call for clerical reform run throughout his works.

Baptista's life and career was a combination of the humanist and the "religioso." He was born a member of the Spagnolo family and the nobility. His father and brothers played influential political roles in the Duchy of Mantua and typified the nobility of fifteenth century Italy as portrayed by Hans Baron. Baptista enjoyed some of the best humanist teachings under the direction of Gregorio Tifernate and Giorgio Merula. Later he attended the University of Padua where he continued his humanist training. Shortly after entering the Order, he became a teacher of the classics where he placed a heavy emphasis upon the value of the learning of antiquity and upon literary form.

Despite this humanist background, Baptista entered into one of the most conservative religious Orders of the day on the basis of a mystical experience rather than training. He maintained throughout his life a complete dedication to the Carmelite Order and its principles. During his career within the Order, he occupied one responsible position after another ranging from Prior to Vicar-General to Prior-General of the entire Order.

Baptista's literary efforts reflect a wide range of

interests that include secular as well as clerical matters. In a majority of his works there is an enthusiastic support of learning, a consistent pleading for the validity and use of the classics, and a great respect for literary form and style. He had only the sharpest criticism for those who looked with suspicion upon the classical literary heritage and had only contempt for the schoolmen of the Middle Ages. His use of the classics indicated that he was quite familiar with this whole field of literature both Greek and Roman. In linguistics he was proficient in both Greek and Hebrew and his skill as a Latin poet was well known. His works ranged from the very secular Eclogues to the very pious Parthenices Marianae. He used often the traditional hagiographical literature in such works as the De Sacris Diebus and the Parthenice. He made wide use of apocryphal literature also and prided himself upon his knowledge of Hebrew literature from which he frequently drew quotations.

Baptista's influence was felt in both Italy and Northern Europe. The Latin poets Sannazaro and Vida imitated his works. Refrigero, Sabbadino and Pico Mirandola praised him as a great humanist. In the North his works were used by schools everywhere in the teaching of Latin and literary form. In England John Colet required that some of his works be used at St. Pauls. Baptista's influence is evident in many English literary works as well. On the continent Erasmus, Wimpheling, Trithemius, and Thomas Wolfe, Jr. all had high praise for him as a humanist, and Europeans everywhere, such as Luther, were well acquainted with his works through their use in the schools. Microfilm $3.25; Xerox $11.25. 250 pages.

THE C.M.S. MISSION OF HELP TO THE SYRIAN CHURCH IN MALABAR, 1816-1840: A STUDY IN PROTESTANT-EASTERN ORTHODOX ENCOUNTER.

(Order No. Mic 60-6772)

Eugene Lester Ten Brink, Ph.D.
The Hartford Seminary Foundation, 1960

The first Chapter is an introductory historical survey of the main lines of development of the Syrian Church in Malabar. It seeks to provide a summary of the extraordinary history of a Church the details of whose origins are lost in the obscurity of the first centuries of this era, but is commonly ascribed by tradition to the Apostle Thomas. It has been under the direct influence of the undivided Church, the East Syrian tradition of the 'Nestorian' Church, the Latin tradition of the Roman Church, the 'Monophysite' influence of the West Syrian Church, the Protestant influence of the Anglican Evangelicals, and is now seeking to rediscover its heritage in the ancient Patriarchate of Antioch in the light of its uniquely varied experience.

To the ecclesiastical history of Chapter I, Chapter II seeks to add the political context of the life of that Church in Malabar, and to provide the setting in the Anglican Evangelical Revival in England for the ecumenical encounter of the Church Missionary Society's Mission of Help to the Syrian Church.

Chapter III seeks to study in some detail that Mission itself, its origin and methods, the influences in India and in England that shaped its destiny, and the course of its work in terms of the personalities involved in encounter and in conflict. Since there were many changes in the personnel of the Mission, the leadership of the Church and the State, and in the forces operating on their work, this period of twenty-five years is divided into four phases for the analytical study of the complex personal and historical factors that determined the outcome of this experiment in inter-church aid.

Chapter IV continues the history of the direct and indirect consequences of the work of the C.M.S. in Malabar. It summarizes the developments that led to the formation of the Travancore Diocese of the Anglican Church and its eventual union with the Church of South India. It also summarizes the development of a reformed party within the Syrian Church and the history of its separation resulting in the Mar Thoma Syrian Church of Malabar, as an embodiment of many of the hopes and convictions of the C.M.S. Mission of Help. It also shows how some of the unanswered questions in the outlook of the C.M.S. in the early 19th century still operate in the life of the Mar Thoma Church, and are the source of unresolved conflicts in its present development. This historical epilogue is followed by an attempt to evaluate the permanent contributions of the work of the C.M.S. in the Syrian Church, as well as the unfortunate consequences of its failure to achieve its original objective of reviving that Church from within while preserving its unity and integrity.

Chapter V attempts a critical evaluation of the various factors that hindered the fulfilment of the original objectives of the C.M.S. This is followed by a summary of findings of this study and suggests some of the conditions for a more fruitful encounter between Protestantism and Eastern Orthodoxy which benefits from the experience of both the achievements and failure of this significant experiment in inter-church aid early in the last century when the Evangelical Anglicans initiated what has become so vital a concept in contemporary thinking about the life and mission of the Church. The Appendices provide valuable but not easily available documentary evidence regarding three of the critical periods of the long history of the Syrian Church in Malabar.

Microfilm $4.60; Xerox $16.20. 357 pages.

INFLUENCE OF DIETARY PROTEIN ON LIVER CONSTITUENTS OF TUBERCULOUS AND NON-TUBERCULOUS GUINEA PIGS

(Order No. Mic 61-1138)

Roberta Ellen Bleiler, Ph.D.
Michigan State University, 1958

The amounts of fat, nitrogen, sulfur, solids, flavin adenine dinucleotide, flavin mononucleotide plus free riboflavin, and the activity of gluthathione reductase were determined in the livers of tuberculous and non-tuberculous guinea pigs on different protein intakes. During 40- and 47-day experimental periods, purified diets containing 35 and 25 per cent protein were fed to 39 control guinea pigs and to 28 animals that had been inoculated with M. tuberculosis H37Rv. The tuberculous animals consumed greater quantities of ration than did their respective controls, but failed to utilize the feed for weight gain as well as did the non-infected guinea pigs.

The enlargement of the livers of the tuberculous guinea pigs indicated that possible structural and functional alterations had occurred in the organ during the infection. The percentages of solids in the livers of the tuberculous animals were lower and the percentages of water higher than those for the respective controls. Tuberculosis appeared to have little effect on the percentages of fat, nitrogen, and sulfur in the livers of the animals. Limitation of dietary protein did not significantly alter the concentrations of these constituents in the livers of the guinea pigs.

Estimation of the activity of liver glutathione reductase suggested that mechanisms responsible for maintaining reduced glutathione in the livers of the guinea pigs were not disturbed either by the presence of tuberculosis or by the restriction of dietary protein. A higher value for the percentage of flavin mononucleotide plus free riboflavin fraction in the liver was found for guinea pigs which received the lower protein ration than for those consuming the 35 per cent protein diet. The concentration of flavin adenine dinucleotide per gram of liver tissue decreased during tuberculosis in the guinea pigs. It is possible that alterations occurred in the flavin adenine dinucleotide-linked enzyme systems of the livers of the tuberculous animals. The relationship between riboflavin retention and nitrogen storage in liver was not maintained during tuberculosis. Microfilm $2.75; Xerox $6.40. 131 pages.

SOME ENVIRONMENTAL INFLUENCES ON FOOD HABITS OF WOMEN CLERICAL WORKERS

(Order No. Mic 61-2545)

Alice June Bricker, Ph.D.
New York University, 1961

This investigation is concerned with the food habits of late adolescent women clerical workers in relation to certain familial and other societal factors. Most of them lived at home, subject to direct family influences, restraints, and pressures, yet spent a major portion of the day in a nonfamilial work setting.

The tendency toward early marriage and parenthood has focused new significance on nutrition education of teenage girls. The literature reveals that food habits of women clerical workers, the largest single occupational group of women in the United States, has received little attention. In 1958, 47 per cent of the women workers were eighteen and nineteen years old.

The instruments used to carry out this survey investigation were: a coded questionnaire-incomplete sentence form in twenty parts; a thirty-minute tape-recorded interview; twenty-four-hour dietary recall. Before undertaking the research, a pilot study was carried out at the Equitable Life Assurance Society of the United States, in New York City.

Through the cooperation of the America Fore Loyalty Group, in New York City, 113 subjects were secured. All were female clerical employees, unmarried, and high school graduates. The coded questionnaire was administered simultaneously to the total group. Tape-recorded interviews were held with twenty subjects, randomly selected from the total group. Luncheon companions of the sample group also answered the questionnaire, and had tape-recorded interviews. Food habits of the mothers of the random sample subjects were investigated by questionnaires and tape-recorded interviews. All investigations were carried out in March, April, and May, 1960.

The group was relatively homogeneous as to social class. About one-third were of Italian descent, and almost a sixth were Irish; in all, over twenty nationalities were represented. In the random sample, families ranged in size from three to seven members. Eleven mothers worked outside the home; fathers' occupations ranged from unskilled to skilled employment.

Generally, food choices were consistent with those of comparable groups. Milk and milk products, citrus fruit, and green, leafy, and yellow vegetables were foods least chosen.

About half the group had satisfactory breakfasts. At lunch, for every three subjects who chose a sandwich one selected a hot meal. The usual evening meal pattern was a meat, potato, and one or two cooked vegetables. Not quite a fifth of the group had salads, and more than half had dessert.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

Approximately 70 per cent had coffee and coffee cake during a morning break; fewer than 60 per cent had something in the afternoon (usually candy); approximately 70 per cent had cake and milk, or coffee in the evening.

Hamburgers and pizza, and soda or coffee were foods chosen either on a date or with peers of their own sex. Foods served at one's own party or anticipated at other parties were drinks, usually soda, with potato chips and pretzels available throughout the evening and later, cake and coffee.

Apparent factors influencing food choices were personal preference and sensual gratification; hunger and thirst; family influence; and health (including weight control); peer mores, approval, and expectations; and time.

Other factors that apparently influenced food choices include: the employer-subsidized cafeteria, food and beverage service available at the morning break, but not in the afternoon, space facilities at home, and limited food experiences. Factors of little discernible influence were: working mothers, high school instruction on food selection; responsibility for food purchasing and preparation; nationality; marriage plans.

Implications for nutrition education emphasize the need to evaluate basic assumptions, subject matter, and methods of teaching. Microfilm $3.50; Xerox $12.40. 272 pages.

COMMUNICATION AND MARITAL INTERACTION: AN EXPLORATORY STUDY.

(Order No. Mic 61-2360)

Helen Eidson Buchanan, Ed.D.
The Pennsylvania State University, 1961

The purpose of this investigation was to determine the extent to which a class experience based on discussions and other material relevant to marital interaction in various areas would affect a change in the degree of communication between a given husband and wife. In this exploratory study, the focus of interest was on the changes made by each individual as indicated by responses made on the two forms of The Communication Assessment Inventory developed by the investigator. The lack of change was determined by comparing the answers given on the two different forms of the Inventory which were administered at the beginning and at the end of the experimental period to both the experimental and control groups. Another objective of the present study was to determine, in those cases where statistically significant differences were noted, the direction of change. If greater consensus were reached the change was counted as positive; if there were less agreement the change was counted as negative.

One of the objectives of functional marriage courses at the college level is to help persons improve their skill in communication in the areas related to marriage and family living. It is assumed that skill in communication is developed through learning. Therefore, it was hypothesized that: exposure to the class experience would stimulate and provide an opportunity for change in communication skills to take place.

Two groups of undergraduate married men and their wives served as subjects. The experimental group was composed of fifteen men who registered for a one-credit course in preparation for marriage at The Pennsylvania State University in the spring of 1958, and their wives. The control group was composed of fifteen married undergraduate men and their wives, who, when contacted, agreed to take part in the study. Four of these couples did not take Form II of the Inventory; therefore, the data for the control group were based on eleven couples.

The experimental group was enrolled in a special section of a class on preparation for marriage. Form I of the Inventory was administered at the initial class meeting and Form II was administered at the end of the last class session, eight weeks later. The class sessions were held one evening each week for two hours, and were relatively unstructured discussions supplemented by films, short lectures, small group discussions, and readings which were related to marital interaction. Activities were aimed at providing the subjects with an opportunity to improve communication skills in areas related to marital interaction.

At the end of the experimental period Forms I and II for each subject were compared and each change made by the subject counted, and a "change" score was computed. The change scores for the experimental and control groups were compared by the use of the Mann-Whitney U test to decide whether or not statistically significant change had occurred. Forms I and II for each couple were compared to determine if the changes made were in the direction of greater or lesser consensus.

It was found that for some parts of the Inventory the experimental subjects made a significantly greater number of changes than did the control subjects. For parts where significant differences were shown, it was found that the experimental group made a preponderance of positive change, i.e., achieved greater consensus. A comparison was made of the changes made by husbands and wives, and it was found that the men in the experimental group made more changes than any subjects; the control group men made more changes than the women in either group, and the experimental group women made more changes than did the women in the control group.

These findings support the hypothesis that when exposed to the experimental treatment designed to facilitate communication in marriage, change did occur and for the most part, in the direction of greater consensus. Therefore, it was concluded that it was possible to stimulate and bring about statistically significant changes in a couple's pattern of communication and marital interaction.

Microfilm $2.75; Xerox $6.60. 136 pages.

EFFECTS OF DIETARY SODIUM LEVELS UPON MATERNAL RESPONSES OF PYRIDOXINE- AND DEOXYPYRIDOXINE-FED PREGNANT RATS

(Order No. Mic 61-2381)

Avanelle Kirksey, Ph.D.
The Pennsylvania State University, 1961

The effects of a dietary sodium chloride deficit and surfeit upon maternal responses during normal and pyridoxine-deficient complicated pregnancies in rats were investigated. Pregnant and non-pregnant animals were

administered either pyridoxine or deoxypyridoxine and one of three levels of dietary sodium (1.4, 6.3 or 54.8 mEq/100 gm of diet) during pregnancy or for a comparable three-week period. Pyridoxine deficiency was intensified by feeding the antagonist for approximately one week prior to the beginning of the experimental period. Sodium and potassium balances; urinary excretion of sodium and potassium; sodium and potassium of plasma, muscle, bone and brain; hematocrit; hemoglobin and plasma total protein were determined weekly. Protein fractions were separated electrophoretically on days 1 and 21.

The data indicated that pyridoxine-fed pregnant rats on the high sodium intake responded in a manner similar to control animals. However, the generally advocated restriction of dietary sodium during pregnancy led to marked changes in sodium and potassium concentrations of maternal tissues and fluids and to a syndrome resembling sodium depletion. Although marked conservation of urinary sodium was evident in the low sodium group, sodium and potassium retentions were significantly decreased. In addition, significantly lower levels of sodium in plasma, muscle and bone and a slightly lower level in brain were associated with increased concentrations of potassium in plasma and muscle and with a decrease in brain. Hematocrit levels and concentrations of hemoglobin and total protein were significantly increased indicating a tendency toward hypovolemia. Although all pyridoxine-fed pregnant groups had increased percentages of alpha$_1$ globulin in plasma total protein and decreased percentages of gamma globulin, the concentrations of all protein fractions were higher for pregnant animals on the low sodium intake than for those on higher intakes. This finding appeared to be a reflection of hypovolemia. No differences in electrolyte balances, fluid or tissue levels, hematocrit, hemoglobin, plasma total protein or protein fractions were observed in the pyridoxine-fed non-pregnant groups. It is suggested, therefore, that the stress of pregnancy produced a relative deficiency of sodium. On the basis of these findings, restriction of dietary sodium during pregnancy appears unsound.

In the deoxypyridoxine-fed pregnant groups, sodium restriction led to signs of sodium depletion which were less pronounced than those in the pyridoxine-fed group. However, the complications of pregnancy produced by the pyridoxine deficiency were intensified. Deoxypyridoxine-fed animals had negative sodium and potassium balances, decreased muscle sodium, and increased muscle and brain potassium levels. However, plasma sodium and potassium concentrations were not significantly affected by pyridoxine deficiency. Plasma gamma globulin was decreased in concentration and in percentage of total plasma protein as a result of pyridoxine deficiency but other fractions were not significantly different from control values. Both hematocrit levels and hemoglobin concentrations were decreased in the deoxypyridoxine-fed groups. Beneficial effects of a dietary sodium surfeit in overcoming some of the derangements in electrolyte metabolism in the pyridoxine-deficient animal were evident. Also, it appeared that some of the complications of pregnancy, produced by pyridoxine deficiency and intensified by dietary sodium restriction, could be alleviated to some degree by the administration of diets high in sodium.

Microfilm $2.75; Xerox $5.60. 115 pages.

CLOTHING VALUES AND THEIR RELATION TO GENERAL VALUES AND TO SOCIAL SECURITY AND INSECURITY

(Order No. Mic 61-2382)

Mary Lapitsky, Ph.D.
The Pennsylvania State University, 1961

The study was undertaken to investigate (1) the relative importance of selected values in the clothing behavior patterns of women, (2) the relation between selected clothing values and specified general values, and (3) the relation between feelings of social security-insecurity and clothing values.

The values included in the clothing value scale were the aesthetic (concern with beauty); economic (desire for comfort and conservation of time, energy, and money in relation to clothing usage); political (desire for prestige, distinction, leadership, or influence); social I (expression of regard for fellow beings through clothing behavior); and social II (desire for social approval and conformity).

Data were collected from two groups of women, 80 undergraduate students and 80 teachers, at The Pennsylvania State University during July and August of 1959. The subjects were required to complete a series of self-report instruments: a forced choice clothing value measure, the Allport-Vernon-Lindzey Study of Values, a measure of social insecurity, the Taylor Scale of manifest anxiety, and a background information questionnaire.

Three hypotheses were drawn which postulated that the aesthetic and economic clothing values would be more important to the women than any of the other clothing values selected for study; positive relations would exist between clothing values and parallel general values; and for the socially secure group of women, the aesthetic clothing value would be more important than the social II while for the insecure group of women, the social II clothing value would be more important than the aesthetic.

With a predetermined level of significance of .05, analysis of the data according to the hypotheses postulated revealed that all of the hypotheses were confirmed.

When mean scores were computed for the clothing values, the aesthetic was the highest and the economic ranked second for both groups of women, teachers and students. For the teacher group, the social II clothing value mean score was third in importance and the political was fourth; the reverse order of importance of these two values was found for the student group--the political was third in importance while the social II ranked fourth. The social I clothing value was of least concern to both groups of participants. When t-tests were performed, the differences between the mean scores were found to be significant except for that which occurred between the student group's political clothing value (third highest) and the social II (fourth highest); these scores were practically identical.

A positive correlation was found between each of the clothing values and their parallel general values, the aesthetic, economic, political, and social (I). The correlations for the teacher group between the aesthetic clothing and general values and between the political clothing and general values were highly significant. For the student group, significant correlations were found between the aesthetic, between the political, and between the social I clothing and general values. Eleven out of 12 correlations between clothing values and non-parallel general values were negative for the teacher group; for the student group,

8 out of 12 were negative. (Two of these four non-negative correlations for the student group were .00 and .01.) When a mean correlation was computed for the parallel clothing and general values, the result was significant for both the teacher and student groups.

Differences were found between the socially secure and insecure groups' clothing value mean scores. For the socially secure groups of participants, the aesthetic clothing value mean score was significantly higher than the social II while for the two groups of insecure women, the social II clothing value mean score was significantly higher than the aesthetic. In addition to the above two, the economic clothing value mean score of the socially secure teacher group was significantly higher than the economic clothing value mean score of the insecure teacher group.

Microfilm $2.75; Xerox $5.40. 107 pages.

LANGUAGE AND LITERATURE, GENERAL

THE HISTORY OF THE LEXINGTON THEATRE FROM THE BEGINNING TO 1860. (VOLUMES I AND II).

(Order No. Mic 61-293)

Mabel Irene Tyree Crum, Ph.D.
University of Kentucky, 1956

Director: Grant C. Knight

Although various amateur dramatic groups, such as the Thespians, the Roscians, student players from Transylvania Seminary and the Military Society had given sporadic theatrical entertainments in town since 1790, the actual history of the Lexington theatre begins in October, 1808, when Noble Luke Usher established the first professional theatre in Kentucky in a building provided by his relative--uncle or father--Luke Usher, a local business man, who served, a part of the time, at least, as manager of the institution. Noble Usher and his wife, both experienced troupers from the eastern stages of Boston, New York, Quebec, continued acting in the local theatre and trying to attract professional groups from the East to its boards until Usher's death in 1814.

The first professional company to maintain anything like an extended season in the West was William Turner's group who arrived in Lexington in December, 1810, and played regular engagements during 1811 at the three theatres on the Kentucky circuit: in Lexington, in Frankfort, and in Louisville. His activities, though, were interrupted by the War of 1812 until the spring of 1815, when he returned and played seasons at the three theatres throughout the year. By December, however, Samuel Drake of Albany, New York --with whom Noble Usher, just before his death, had negotiated an agreement for Drake's managership of the Kentucky theatrical circuit--pressed his claim so vigorously that Turner left town under a cloud of litigation against Luke Usher, who the actor insisted had broken a contract with him.

The era of management under Drake's company from 1816-1819 marks the highlight of the Lexington theatre before 1860. Originally from England, the showman and his company, composed for the most part of his own children, were undoubtedly far superior to all preceding troupes that had visited the West in ability and training. Too, the economic and social factors of Lexington at this time were apparently favorable for a successful theatre. Drake also had connections both with the East and with England which made it possible for him to bring some of the best talent in both countries to the Kentucky stages. Two members of his company relate the Lexington theatre to the national picture: Miss Frances Ann Denny, the little novice, who as Mrs. A. Drake, the old manager's daughter-in-law, became one of the outstanding tragediennes of the early nineteenth century, and N. M. Ludlow, an inexperienced amateur, who left the Kentucky theatres to help establish the Nashville theatre, according to his own account, and who later in life wrote the best single account of the early theatres in the United States west of the mountains, Dramatic Life as I Found It.

By 1820, the halcyon days for the Lexington theatre were over. Many factors combined to bring about its decline: the opposition of the church, an economic crisis peculiar to Kentucky, inspired by its banking legislation, the opening of the Ohio river to navigation which shifted the economic emphasis from Lexington to Cincinnati. During the decade of the twenties Joshua Collins and William Jones maintained a few theatrical seasons on the Kentucky circuit which were notable for the fact that Edwin Forrest began his acting career in the company.

The theatrical decline which began in 1820 continued through the thirties and forties, aggravated in the 1830's by the cholera epidemic in Lexington in 1832 and 1833 and by the national money panic of 1837. J. S. Potter, one of the most colorful characters in the western theatre, served as manager during 1835-36, but his season, as did so many others, apparently died for the lack of public support. The theatre everywhere in the 1840's was plagued by what Odell calls "the limpets of the theatrical body"--family singing groups, chemical dioramas, minstrel companies, Swiss bell ringers, and other semi-vaudeville acts. Lexington had its share of these activities, but little of the legitimate drama. There were periods when the town did not even have an adequate building, Usher's theatre long since having been sold under the auctioneer's hammer. During the forties someone built a new theatre, apparently a make-shift affair, judging from the meager publicity it received, and H. Coleman leased it for a few months. During this period Edwin Forrest, in the hey-day of his career, returned for a short engagement. This theatre, too, ceased to function after a short time. Later, plays were given in the Masonic building, and in the second story of a drug store, fitted up as the Melodeon Hall.

By the 1850's Lexington had apparently reached the

point of demanding the return of the theatre after a long dramatic famine. A group of townspeople organized a corporation for the purpose of building the Odd Fellows' Hall, the lower floor of which was equipped as one of the finest theatres in the West, according to the newspaper accounts. During 1856 and 1857, under the managership of W. H. Hough, the town enjoyed the most brilliant theatrical season of its history to this point. Some of the brightest stars of the theatrical firmament played engagements on the new stage. After a short time, however, it became apparent that decline had once again set in, and in September, 1857, the newspapers carried scathing accusations of rank dishonesty on the part of the lessee, who had left town precipitately. Other managers attempted short seasons, but during the remainder of the decade, the theatre never regained the vigor nor received the support which attended the opening of the new Odd Fellows' Hall and the revival of the legitimate stage in Lexington.

Microfilm $8.45; Xerox $30.15. 666 pages.

IZAAK WALTON'S LIFE OF SIR HENRY WOTTON, 1651, 1654, 1670, 1672, 1675: A STUDY OF SOURCES, REVISIONS, AND CHRONOLOGY.

(Order No. Mic 61-2141)

Richard Edwin Fehner, Ph.D.
University of Minnesota, 1961

Izaak Walton owed his career, both as a biographer and as the author of The Compleat Angler, to the indolence of his friend Sir Henry Wotton. After the death of John Donne in 1631, Wotton planned to write his biography, and he enlisted the aid of Walton. Then Sir Henry died in 1639, and since no life of Donne was found among his papers, Walton reviewed his "forsaken-Collections" and brought out The Life and Death of Dr. Donne in 1640. Walton tells us that he "became ingag'd, into a necessity of writing the life of Doctor Donne; Contrary, to my first Intentions. And that begot a like necessity of writing the life of his and my honoured friend, Sir Henry Wotton." The Life of Wotton first appeared in 1651, as an introduction to Reliquiae Wottonianae, and revised versions were published in 1654, 1670, 1672, and 1675. Scholars agree that the Life of Wotton is "the most objective, the most worldly and entertaining" of all Walton's biographies.

For much of the information in the Life, Walton relied on his personal knowledge of his subject. But he was also indebted to the memories of his many friends. Moreover, as the editor of the Reliquiae Wottonianae, Walton was well-supplied with original documents, and he made particular use of Sir Henry's correspondence in putting together the Wotton biography. Supplementing his hearsay evidence and Wotton's literary remains, Walton employed "scattered books and records."

It has already been suggested that the Life of Donne (1640) led to and inspired the Life of Wotton (1651), which two memoirs comprise a unit of Walton's biographical work. Not only did Walton handle his material in the same way, but even the circumstances surrounding their composition were similar. Realizing that the lives of Donne and Wotton were somewhat parallel at certain points, Walton either recalled or turned to the Life of Donne while phrasing the Life of Wotton. Walton "could seldom rest satisfied with one use of a good phrase or idea."

In the later issues of the Life of Wotton, especially in 1654, Walton expanded his earlier account. He added half a dozen new passages to this second version, including two poems and two letters. His transcriptions of both the letters and the poems show that Walton did not balk at altering material if he felt that he could improve or clarify it. Besides enlarging the Wotton biography, Walton constantly modified and emmended what he had written earlier; his most interesting revisions are found in the version of 1672. In 1670 Walton presented a copy of the Lives to Anthony à Wood, who made several observations and corrections in the margins of the Life of Wotton. Next, he must have acquainted Walton with his marginal notes, because in 1672 Walton adopted some of Wood's data, although he did have enough faith in his sources to reject a number of Wood's emmendations. As a reviser, Walton's typical practice was to amplify and embellish his sentences, frequently revealing new information. He also corrected previous mistakes, kept the Life up to date, clarified obscure comments, introduced qualifying expressions, and reworked portions of the biography so as to make them more credible.

Some critics feel that Walton did not pay sufficient attention to matters of chronology in the Lives. And yet, he was far from indifferent about the time element. He became increasingly aware of the importance of dates, and his mistakes in dating the occurrences of Sir Henry's youth were undoubtedly due to the tenuousness of his material. When he had access to printed matter, Walton's chronology, at least by 1672, was more accurate.

Microfilm $2.75; Xerox $8.80. 191 pages.

PORTRAIT OF EMILY DICKINSON: THE POET AND HER PROSE.

(Order No. Mic 61-2213)

David James Monroe Higgins, Ph.D.
Columbia University, 1961

Emily Dickinson's letters are similar in kind, if not in intensity, to her poems. They clarify her mental growth during her early years; their themes, diction, and rhythm parallel her poetic development; in later years, highly stylized, they become a recluse's substitute for conversation. Together with letter-poems mailed to friends, they provide a reliable basis for biography.

Emily Dickinson, as her first letters reveal her, was a shy, precocious child devoted to her family. In adolescence she resisted, after brief acceptance, the social, religious, and literary conventions of her day. By her twentieth year her prose had the characteristic three-stress rhythm of her earliest poems. During the 1850's her letters became epigrammatic. By 1858 she was experiencing "ecstatic moments" which she was able to capture in prose and verse.

From 1858 to 1865 Emily wrote poems at an alarming rate. Fearful for her sanity, she relied on a series of "scholar-preceptor" friendships. Her chief "master" of these years was Samuel Bowles. Although drafts of love-letters from "Daisy" to "Master" do not name the master,

one letter-poem describes Emily as "the daisy" Bowles had "plucked"; in ardent letters, Emily also called herself his "queen" and likened Bowles to Christ.

Bowles did not reciprocate. In April 1862, seriously ill, he sailed for Europe; six days later Emily first wrote to T. W. Higginson, her literary preceptor. In May Rev. Charles Wadsworth, Emily's spiritual guide, moved to California. These events, plus the tensions of the Civil War, may explain the vast number (though not the quality) of Emily's 1862 poems. When Bowles returned from Europe in November, Emily refused to see him. The break between the two probably lasted until 1874.

The mingled "royalty" and humility of the "Master" episode outlived the ardor that provoked it. More devoted to poetry than to any friend, Emily slowly withdrew from society. Her friendships-by-mail became increasingly important to her. For each correspondent she adopted a separate tone. So impressive were her letters that Helen Hunt Jackson wrote a short story about her. But little is known of her outward life and conversation except for two interviews with Higginson and the crises caused by Emily's pretentious sister-in-law.

The deaths of Emily's father in 1874, Samuel Bowles in 1878, and Charles Wadsworth in 1882, led to a new kind of friendship: Emily's "sacred" correspondences with close friends of her "Lost." One of these, Judge Otis Lord, became Emily's final "master" about 1878. The ardor was mutual; the judge probably proposed marriage. Drafts of letters to Lord show that Emily's seclusion did not depend on unfulfilled love. Sacred correspondences with friends of her "precious" Samuel Bowles and her "heavenly father" Dr. Wadsworth indicate the nature of Emily's devotion to these men.

In her last years Emily Dickinson was often ill. There were more "Lost" to mourn: her nephew Gilbert in 1883, Judge Lord in 1884, Helen Hunt Jackson in 1885. In spite of grief, however, Emily retained her mental balance and lively wit; in spite of seclusion, she cultivated new friends like her posthumous editor, Mabel Loomis Todd. Emily's late letters reveal new stylistic developments. Narratives and prose elegies became frequent, while distinctions of tone between correspondences diminished until all her letters were much alike. But the essential qualities of Emily Dickinson -- acute perception, humor, painful shyness, and intense devotion to family and friends -- continued to the end. Microfilm $3.85; Xerox $13.50. 299 pages.

DICKENS AND THACKERAY: THE RECIPROCAL INFLUENCES.

(Order No. Mic 61-2234)

Edward Eugene Irwin, Ph.D.
The University of Florida, 1961

The study is concerned with the relationship of Dickens and Thackeray within the framework of the peculiar literary situation in which they competed with one another. The central problem is to show that each was an influential force working upon the other in all phases of their careers. To do it, the study defines and illustrates two kinds of influences which figured prominently in shaping the professional careers of Dickens and Thackeray, careers which, though not parallel, were strikingly similar in scope and development. First is the influence which each had on the other; second are the outside influences which they shared in common. An investigation of the writings of these two authors, of the development of their careers not only as writers but as editors and stage performers as well, of the public for which they wrote and performed, and of the writing of some of their contemporaries shows that the career of each had an unmistakable influence on the career of the other. The same evidence shows that Thackeray and Dickens had several common goals--money, popular applause, critical acclaim, prestige among their fellows, and posthumous fame--all of which played a material part in shaping their careers.

These influences are significant because they were partly responsible for some of the best fiction in the English language. The almost overwhelming volume of the work of Dickens and Thackeray resulted in part from the constant pressure of competition, from the driving ambition to achieve and maintain a high place in their profession, and from the understandable desire to acquire a great amount of money. The continued success of each author in every phase of his career acted as a spur to the other.

The investigation concentrates on five main points which are pertinent to a thorough study of the coextensive careers of Thackeray and Dickens: their first ten years in the literary profession, their Christmas books and travel books, their magazine editing, their lecture tours and public readings, and the literary market and popular audience of mid-Victorian England.

There is no comparable example in the history of English literature of any other pair of authors who pursued contemporaneously such full and remarkable careers and who, throughout those careers, had fixed goals in common and exerted an influence on one another.

Microfilm $2.75; Xerox $6.80. 142 pages.

A CRITICAL 3rd EDITION OF EDMUND TILNEY'S THE FLOWER OF FRIENDSHIPPE, PUBLISHED IN 1577, EDITED, WITH INTRODUCTION, NOTES, AND GLOSSARY.

(Order No. Mic 61-1872)

Ralph Glassgow Johnson, Ph.D.
University of Pittsburgh, 1961

Edmund Tilney (c. 1536-1610) dedicated his only literary production, The Flower of Friendshippe, to Queen Elizabeth I, whom he served as Master of the Revels (1579-c.1610) during the glorious days of the Elizabethan stage. His father, Philip Tilney, was Usher of the Privy Chamber to Henry VIII; and his mother, Malin (Chambre), was of the household of the unfortunate Queen Catherine Howard. A courtier by birth and by preference, Tilney apparently owed his appointment as Master to his connection by ties of kinship with the powerful Howard family. His methodical records of the Revels Office and his stern censorship of the play Sir Thomas More, believed to have been co-authored by Shakespeare, indicate the type of surveillance he exercised over Elizabethan dramatists.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

First published in 1568, The Flower of Friendshippe ran through two subsequent editions in 1571 and 1577. The third edition text, based on the Wood 736 (3) copy in the Bodleian Library of Oxford University, was selected for editing because it seemed to have received Tilney's final revisions and corrections. I have collated it with two versions of the 1568 text. As first editor, I have taken the liberty to identify the various editions by alphabetical symbols. Thus, the probable earliest first edition text, I call A1; the revised first edition text, A2; the uncollated second edition text, B; and the third edition text, C. Each new edition departs farther from the norm of modern spelling.

Written in a flowing rhetorical style, which is free from euphuistic conceits but sprinkled with many words of French origin, The Flower of Friendshippe imitates the garden setting of Boccaccio's Filocolo and Decameron, where a group of ladies and gentlemen assemble at a lady's house to elect a queen and to discuss a serious subject. The Italian conversazione form and, to some degree, the characters are modelled after Castiglione's Courtier. These qualities, heightened by the exclusion of all coarse and vulgar expressions, give the book a tone of refinement and sophistication.

Within this artistic framework Tilney presents typical Elizabethan views on marriage. While Master Pedro describes the duties of the married man in conventional terms, Master Gualter, the merry misogynist, vents his diatribes in dispraise of women. While the charming widow, Lady Julia, describes the conventional married woman, her daughter, Lady Isabella, sets forth the views of the emancipated modern woman. The breadth, the condensation, and the delicate antithetical structure display Tilney's literary artistry to advantage.

In addition to Boccaccio and Castiglione, Tilney's sources include the marriage treatises of Erasmus and others, and Vives' Instruction; the short prose tale collections, especially Painter's Pallace and Marguerite de Navarre's Heptameron; and the proverb lore of Heywood's Dialogue. Tilney shows preference for prose writers, especially historians: Plutarch, Sabellicus (Marcantonio Coccio), Baptista Fulgosa, Herodotus, Diodorus Siculus, Dionysius of Halicarnassus, Valerius Maximus, Cicero, Plato, Xenophon, Seneca, Pliny the Elder, and Pliny the Younger. The only poets he mentions are Hesiod, Menander, Anacreon, and Martial.

R. W. Bond has traced Tilney's influence on Lyly's Euphues. I have found parallels of his proverbs in Pettie, Lyly, and Shakespeare. The 1575 edition of Gascoigne's poems is arranged according to Tilney's "flowers," "herbs," and "weeds." Like The Flower of Friendshippe, Spenser's Faerie Queene presents a woman ruler while the poem's dedication to Queen Elizabeth echoes the Flower's Epistle Dedicatorie. Tilney certainly antedates Nashe's Unfortunate Traveller in placing Erasmus and other humanists in a pseudo-historical, anachronistic setting; and Arthur Dickson (N. Y. C.) has traced another parallel in Greene's Penelope's Web. Therefore, Tilney apparently exerted a minor influence on Lyly and other Elizabethan writers.

Microfilm $3.60; Xerox $12.60. 279 pages.

MATTHEW ARNOLD AS SATIRIST

(Order No. Mic 61-2317)

John Bertrand Lott, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor Edgar Hill Duncan

Geoffrey Tillotson in "Matthew Arnold: The Critic and the Advocate," published in Essays by Divers Hands (1943), suggested that Arnold did not himself practice always the critical principles he preached. He found that Arnold was often an interested partisan rather than a disinterested critic, that he was indeed so interested that he became at times a satirist. E. K. Brown, in Matthew Arnold: A Study in Conflict (Chicago, 1948), explored in detail the first half of Tillotson's assertion -- that Arnold was often a partisan. The purpose of this thesis is to examine in detail the second -- that Arnold was a satirist.

The presence of satire in Arnold's works was commented on even during his lifetime by Henry James ("Matthew Arnold," English Illustrated Magazine, 1884), but no one has yet determined the extent to which he was a satirist or analyzed the devices by which he accomplished his satire. The present study considers these problems by an examination of works representing the whole of Arnold's career as a prose writer. The introductory chapter establishes the definition of satire on which the study is based and relates Arnold's satiric devices to that definition. The body of the thesis follows the chronology of Arnold's production (with slight alterations to group essays according to subject matter) and explores and evaluates the use made of satiric devices at each stage of his career.

Chapter II studies Arnold's early criticsim and finds that in such works as On Translating Homer brief turns to satire, although they do not always form integral parts of Arnold's arguments, do foreshadow many of the satiric techniques and attitudes of Culture and Anarchy and Friendship's Garland. In the major social works, as he becomes less the disinterested critic and more the dogmatic reformer, Arnold allows himself more freedom in the use of satire.

Chapter III determines that, although no one satiric device is employed throughout Culture and Anarchy, the ironic self-depreciation, satiric character sketches, satiric terms and schemes, and the incidental ironies contribute to a satiric view of the whole of mid-nineteenth century English society. Friendship's Garland, the subject of Chapter IV, is Arnold's most satiric work. In it he establishes an ingénu pose for himself, creates a persona in Arminius von Thunder-ten-Tronckh, and imagines in the Bottles family and their acquaintances a group of satiric "typical" characters. By these techniques -- organized by the class structure represented by the members of the Bottles circle; by the rudimentary plot, which provides a narrative framework for the revelation of Arminius' doctrines; and by the fiction of the memorial volume -- Friendship's Garland supplements and clarifies the satiric picture of English society which the reader gleans from Culture and Anarchy.

The major religious works, examined in Chapter V, do not employ satiric devices as widely as do the major social works. However, in Literature and Dogma and God the Bible satire against speculative theology and against

Dissenting religious sects forms a significant undercurrent. In the essays which follow the religious works, as Chapter VI shows, satire is likewise occasionally resorted to, especially in the essays on English relations with Ireland and America.

The conclusion reached is that Arnold's employment of satire accompanies his "interested" concern with specific problems of Victorian England. A realization of the necessity for reform led him, almost throughout his career, to good-humored satire of his contemporaries and their values. This satire is accomplished through devices, some of which become characteristic of him, ranging from brief ironies to complex imaginary scenes.

Microfilm $3.25; Xerox $11.25. 249 pages.

AN ANNOTATED EDITION OF HENRY DAVID THOREAU'S WALDEN

(Order No. Mic 61-1500)

David Gordon Rohman, Ph.D.
Syracuse University, 1960

Supervisor: Thornton H. Parsons

Because half a century has elapsed since Henry David Thoreau's Walden was last fully annotated, a gap in Thoreau scholarship has existed which this dissertation attempts to fill. Both the study of American literature as a specialized discipline and the study of Thoreau as a major American author have matured since Francis H. Allen edited Walden with notes in 1910. It is time to synthesize and focus the relevant insights of modern scholarship upon the major text in the Thoreau canon, Walden. Such is the intention of this dissertation.

It provides both annotation and commentary upon those parts of Walden that need or deserve explanation. Notes provide necessary historical dates, identification of names, places, quotations and (where possible) sources of Thoreau's information. Commentary attempts to synthesize the most pertinent insights from a variety of Thoreau scholars--early and late--and to focus them upon the relevant parts of Walden.

Although several problems of annotation remain unsolved, enough new data has been gathered to make this the first complete annotation in fifty years. As a result, we can better appreciate the artistry of Thoreau, the range and depth of his preparation for writing Walden, the extent of his immersion in his time, and the maturation of his own character reflected in the Walden text, which was pieced together over seven years.

Thoreau's place in American literature is secured by this one book, a harmonic fusion of materials from a lifetime of observation and contemplation. Annotation reveals that Thoreau drew from a wide variety of sources--from his own journals and notebooks as well as from other books --and carefully refashioned it all in order to stage the work of his maturity: a celebration of his faith in spiritual renewal.

Annotation also reveals the range of Thoreau's preparation for Walden by extensive reading in English, Bible, Classic and Oriental literatures. A good deal of this reading appears as deliberate quotation or paraphrase (most of it here identified), but unlike so much Victorian writing, his quotations seldom merely ornament the text but rather add to the depth and range of meaning. Annotation reveals that Thoreau's imagination was thoroughly saturated with the Bible so that numerous allusions work themselves into the text almost as "second nature," as art that conceals its artfulness. In addition, it is obvious that a good deal of Thoreau's reading became so much a part of his thought that it is now impossible to separate out specific sources. He was an artist who thoroughly assimilated his materials.

Annotation allows the reader to see, by citation of contemporaneous events, how much Thoreau was a part of his time, reacting to its politics, reforms, personalities and ideas; Thoreau was part of the climate of opinion that included the Fourierism, Manifest Destiny, transparent eyeballs and phrenology. Thoreau was not only a "product of his time" but also a "cause," and Walden "sums up" in literary form the ideal of self-culture by which the American myth of an Adamic paradise is to be regained.

Finally, annotation of Walden reveals the maturation of Thoreau's own attitudes in the years between his stay at the pond (1845-1847) and publication of the book (1854). By careful analysis, we can see his increasing symbolization of events, his reworking of materials such as the famous analogy of rebirth in the thawing sand and clay, and his total ordering of the entire book into a symbolic correspondence of the seasons with the life of man. We can trace back from Walden Thoreau's "second growth" following upon a period of doubt and disillusion in the early fifties. The Thoreau who emerges in Walden is an artist fully matured not only in the mastery of his craft as writer, but also in the depth and integrity of his character.

Microfilm $4.95; Xerox $17.55. 388 pages.

IRONY IN THE WORKS OF HENRY ADAMS

(Order No. Mic 61-806)

Henry Burt Rule, Ph.D.
University of Colorado, 1960

Supervisor: Charles H. Nilon

The objectives of this investigation are to determine the uses, sources, techniques, and values of the irony in the writings of Henry Adams. The plan of attack is to study the irony in Adams' works both chronologically and analytically.

In his journalism Adams used irony as a tool for social reform. In Democracy, Esther, and John Randolph, he used irony as an aid to characterization. In the History of the United States of America during the Administrations of Thomas Jefferson and James Madison, The Education of Henry Adams, and A Letter to American Teachers of History, he used irony as an instrument of philosophy.

The principal source of Adams' irony was his studies in modern science. Science gave Adams the vision of man and the universe which is central in his major works. From the astronomical heights that science provided, Adams could see the human situation in a perspective that is acutely ironic: little man strutting about in all of his vain self-assurance against the enormous backdrop of creation; a tiny insect who believes devoutly that he is the

master of his fate, but who is nothing more than a feeble atom tossed about by the sum of forces that attract him.

Two techniques of irony in the Education and other works of Adams' last period delineate the inability of man to master the new forces of the Age of Multiplicity. One is the Double Technique. This is the process of placing in a narrative context a double or twin who reflects certain aspects of the author's own personality or life. The author can then laugh satirically at himself as if he were watching the antics of a comic actor on a stage. Through the double Technique, Adams not only dramatized his lifelong "pursuit of ignorance," but he also exhibited the blind and futile gropings of most of the statesmen and thinkers who lived during the Victorian Age. The Camouflage Technique was the second method by which Adams expressed his disdain for human intelligence. This was an ironic stratagem whereby Adams adopted certain literary disguises in order to camouflage his true beliefs and intentions. By means of this technique, Adams played elaborate jokes on his readers, satirized his own mental frustrations and confusions, attacked a society that rewarded the mindless and the selfish, and lampooned a universe stripped by science of purpose and divine love.

Most of the controversy concerning the moral and aesthetic value of Adams' irony has centered on the Education. The Education is not, as some critics have described it, a cynical and meaningless gesture of disgust. The purpose of Adams' ironic attack on the bankruptcy of the human intellect is, paradoxically, not to ridicule mind as such, but to urge upon man the necessity for new mental energies in order to control the exploding scientific and industrial energies of modern times. Equally in error are those critics who attack the Education for its factual errors and distortions; for this book is not primarily autobiography, history, or philosophy, but it is one of the world's greatest works of satire and irony.

Microfilm $3.55; Xerox $12.40. 273 pages.

A STUDY OF THE MATURING OF BEN JONSON'S METHODS OF CHARACTERIZATION

(Order No. Mic 61-1709)

Maxine Kent Valian, Ph.D.
University of Southern California, 1961

Chairman: Professor Arnold

The dissertation is a critical analysis of Ben Jonson's six major comedies: Every Man in His Humour, Every Man out of His Humour, Volpone, Epicoene, The Alchemist, and Bartholomew Fair. The purpose is to trace Jonson's growing mastery of specific methods of characterization and to demonstrate the relationship between the artist's maturing powers of characterization and his total achievement as comic dramatist. The method is an examination of each comedy in the four major areas which define character development in Jonson's plays: (1) humours and types, (2) action, (3) language, and (4) satire.

Jonson approached the writing of comedies with three primary concepts of character: the classic with its emphasis on types, the native with its interest in allegory, and the satiric with its reliance on exaggerated traits. The allegorical and humour concepts influence Jonson's method more potently in the early plays than in the mature ones. The type concept, predominant throughout Jonson's work, is manifested at the beginning by the original adaptation of conventional types and later by the creation of individualized characters representative of seventeenth-century London society. The allegorical and humour concepts reflect the strong didactic bent of Jonson's talent; the type concept reflects his acceptance of Cicero's definition of comedy as "an imitation of life, a mirror of custom, and a representation of truth." All three concepts reflect the persistent interest of Jonson in comedy as an instrument of social criticism as well as a medium of entertainment.

The humour concept unfortunately has dominated discussion of Jonson's work, and such emphasis has resulted in a misleading caption, "the Jonsonian humour character." Of "genuine" humours as Jonson describes them in the Introduction of Every Man out of His Humour, there are few examples outside the play in which his definition appears. And after Sir Politique Would-Bee in Volpone, even the characters which may be classified as humours fail, either by their complexity or by their involvement in the action, to conform to a strict humour definition. By far the greater number of Jonson's characters are types, which become increasingly varied and individualized as he develops his mature method. Both the humours and the types show a gradual extension of Jonson's command over the diverse materials of his drama. In his three main methods of characterization–action, language, and satire–the pattern of development is similar: a growing integration of elements both provides a meaningful unity and in turn permits a greater variety of expression.

Characterizing action, in the early plays, is the unplotted, at times isolated, movements of individual characters; in the mature comedies, such action is reinforced by a structure that gives meaning to the diverse reactions of the individuals. Characterizing language in the early comedies is employed in expository demonstration scenes which call attention to the individual characters without relating them to a central motif. In the later plays, a dramatic language is developed which both characterizes the individual and involves him with other characters of the scene. Satire in the early plays is incidental to the action and is carried by the exaggeration in individual portraits. Later, satire is achieved by the dynamic grouping of characters and therefore is fused with the main action. The resulting unity allows for a variety of expression that both supports the central theme of the play and exploits the foolish traits of the individual characters.

The maturing of Jonson's methods of characterization is largely a process of his ordering his material so that he takes full advantage of the opposing forces of unity and variety. The result is characters that, interpreted against the background of the entire comedy, show themselves admirably suited to the satiric drama in which they exist.

Microfilm $4.45; Xerox $15.75. 348 pages.

THE WESTMINSTER REVIEW, 1824-1857: WITH SPECIAL EMPHASIS ON LITERARY ATTITUDES.

(Order No. Mic 61-1419)

Rosemary Thorstenson Van Arsdel, Ph.D.
Columbia University, 1961

In 1824 Jeremy Bentham and his followers founded a new quarterly, the Westminster Review, to be devoted to explaining more clearly to the public the principles of Utilitarianism. Bentham supplied the money for the venture and turned the editorial chores over to John Bowring, stipulating that half the Review be devoted to "literary insignificancies."

Utilitarian hostility toward the place of literature in the projected new society has often been recorded. From 1824 to 1837, however, reviews of novels in the Westminster tended to disregard the Benthamites' negative view of literature although those of poetry still judged more often by the standard of utility. In reviewing Scott an honest attempt was made to evaluate his novels without regard to his politics and to analyze historical fiction. Fashionable novels were recognized as social documents. Didactic novels were more subject to strictly Utilitarian judgments.

In 1837, John Stuart Mill assumed the editorship. Under his guidance the Westminster boldly abandoned use of anonymity among reviewers, and, politically, moved from strict Benthamism toward a more all-embracing radicalism. History, biography and comic prose all received a share of attention. Foreign fiction also was reviewed. A brilliance and diversity was achieved which was unique among quarterlies of the time.

William Edward Hickson became editor and owner in 1840 and continued until 1851. He was devoted to educational reform as a means of social change and during his editorship reviews of fiction, poetry and general literature were related purely and simply to social issues. Articles on Dickens, Disraeli, Bulwer and Mrs. Gaskell were all influenced by the editor's ideas on reform. This preoccupation with reform also accounted for the many astonishing omissions from the literary section such as Thackeray, Trollope and the Brontës. Although not a great literary review under Hickson, the Westminster nevertheless followed three useful literary policies during his editorship: vigorous opposition to the use of the anonymous review, opposition to the Taxes on Knowledge and devotion of a good deal of space to reviews of foreign fiction.

John Chapman bought the Westminster from Hickson in 1851 and promptly hired Marian Evans as his assistant editor. She and George Henry Lewes conducted the Review's literary section almost alone during the next five years. Lewes insisted on reality as well as unity and suitable form as touchstones for criticism of literature. Marian Evans explored the moral and ethical aspects of art, the role of women as artists and her growing belief in art as a means of enlarging men's sympathies. Indeed, her years as a Westminster reviewer were fundamental to her later development as a creative artist. After 1857 the Westminster Review had passed its zenith and its influence on thought declined. The last issue was June, 1914.

Appendices 1, 2 and 4 provide new and unpublished biographical material about Hickson and Chapman. Appendices 3 and 5 identify authors of articles.

Microfilm $3.75; Xerox $13.30. 291 pages.

LANGUAGE AND LITERATURE, CLASSICAL

EARLY CHRISTIAN INSCRIPTIONS OF CRETE

(Order No. Mic 61-2016)

Anastasius Constantine Bandy, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Michael H. Jameson

Within the last hundred years archaeological excavations have brought to light, among other things, many inscriptions of importance that have added to the knowledge of the period to which they belong. Among such are also Christian inscriptions.

Although the Christian inscriptions are published in various journals of classical studies upon being discovered, scholars have felt the need for the publication in a special work of all Christian inscriptions. Several significant works have seen the light of publication, which treat of the early Christian inscriptions of a particular area such as those of Asia Minor by Henri Grégoire, those of Egypt by Gustave Lefèbvre, those of Rome by Giovanni Baptista de Rossi and Angelo Silvagni. The work entitled Corpus der griechisch-christlichen Inschriften von Hellas under the auspices of the Christlich-archäologische Gesellschaft zu Athen, established by H. Lietzmann, Nikos A. Bees, and George Sotiriu, plans to include the early Christian inscriptions of the Greek mainland and islands. Volume one, published in 1941 by N. Bees, presents the Corinth-Isthmus inscriptions, eight other volumes pending publication in the future.

The author of this thesis, while on a Fulbright grant for the year 1958-59, in his desire to contribute to the study of the Christian inscriptions of Greece made a study of the early Christian inscriptions of Crete. These are treated in Chapter II. Epigraphical statistics are given, which include a description of the stone in terms of height, width, thickness, and height of letters and mention of place found. A bibliography of the inscriptions, in the case of those that have been previously published, a transcription, translation, and a commentary on the text with cross-referencing follow the epigraphical statistics. Inscriptions recently discovered by the author and others that have come to light since the publication of Margarita Guarducci's work Inscriptiones creticae are included. The commentary deals with items of epigraphical, historical, and lexicographical interest; in the case of the latter references are made to classical, Septuagint, New Testament, and patristic Greek. New words and those exhibiting new or special shades of meaning are noted.

Since little is generally known about Crete during the Christian period, Chapter I is devoted to the introduction and development of Christianity in Crete. Crete in the Imperial Age, the beginnings of Christianity, the first Byzantine period (A.D. 330-824), the early Christian basilicas that have come to light within the last fifty years and the bishops of these areas that are known through literary sources, the period of Arab rule (A.D. 814-960), and the second Byzantine period (A.D. 961-1204) are dealt with in this chapter.

Chapter III, entitled Conclusions, is devoted to a treatment of the Christian inscriptions of the first three centuries, the material, types of those of Crete, guide lines,

an analysis of the symbols, abbreviations, diaeresis, ligatures, spelling and pronunciation, epitaphic formulas, expression of chronology, an analysis of the word ἰνδικτιών, the years of the indiction, the word μήν, the days of the month, the word ἡμέρα, and the days of the week. Since the inscriptions of Crete give examples of the various ecclesiastical offices, both of lower and higher clergy, these are analysed; the various names for them are discussed on the basis of their occurrence in the Septuagint, the New Testament, patristic writers, and Christian inscriptions. After Chapter III, for the sake of an easy reference to all the words that occur in the inscriptions dealt with, an epigraphical index follows, consisting of divine, saint, personal, ethnic, and place names, as well as, ecclesiastic offices, monastics, months, days of the month, days of the week, hours of the day, years of the indiction, age of the deceased, years of monastic life, and words, all listed with their inscription reference. Nine photographic plates of the stones, taken by the author except in the case of a few which are noted, and a map of Crete, indicating both the sites of the early Christian basilicas discovered to date and the places from which early Christian inscriptions have come, follow.

Microfilm $4.75; Xerox $16.90. 371 pages.

SALAMIS AND PLATAEA IN THE TRADITION OF THE ATTIC ORATORS

(Order No. Mic 61-2003)

Fredric William Schlatter, S.J., Ph.D.
Princeton University, 1960

This dissertation is devoted to an investigation of the historical tradition which was followed by the Attic orators in their remarks on the two most important events of Xerxes' war: Salamis and Plataea. The investigation attempts to show that the orators do not irresponsibly rewrite the circumstances and details of these events but follow a genuine tradition based on the popular understanding of Attic history current in Athens during the fifth and fourth centuries.

In establishing this point, it is shown that the orators reflect a conservative attitude towards the use of history which, especially in the case of Isocrates, pledges them to relate historical events in keeping with the knowledge their audiences possessed. The general problem of Herodotean influence on the orators in their understanding of Attic history is examined, and this influence is not found in the case of Andocides and Isocrates but is found to be present strongly in the Epitaphios of Lysias. A more specific examination of this problem in relation to the role of Salamis and Plataea in fifth century Athens yields evidence of the influence the popular conception of the battle of Salamis exercised in the formation of the historical traditions about Xerxes' war to the exclusion of the importance of Plataea. A marked change towards Plataea is noted in the fourth century, but this does not disturb the traditions which had been formed around Salamis. The effect of the preoccupation with the role of Salamis to the exclusion of Plataea is shown to be particularly strong in two matters which Herodotus carefully designates as incidents connected both with Salamis and with Plataea: the Isthmus fortifications and the evacuation of Athens, and in the matter of Persian embassies to Athens which Herodotus assigns only to the time of Plataea. The orators, for their part, place all these incidents before Salamis alone, thus giving a version at considerable variance from Herodotus. The most striking deviation from Herodotus is the question of Alexander's embassy. The persistence of this tradition in later accounts is also treated. A final comparison between Herodotus and the orators shows four incidents which are either at variance with the historian's version or treat matters omitted by him. These incidents deal with Artemisium, Arthmius, the fleets at the battle of Salamis, and the Oath of Plataea.

The results suggest that the orators are competent witnesses to an historical tradition older than Herodotus which his influence did not modify. The chief conclusion, therefore, is that the orators are reliable witnesses to a popular version of history, which, even if inaccurate, represents the sort of history Athenians recognized as their own. Microfilm $2.80; Xerox $9.70. 213 pages.

LANGUAGE AND LITERATURE, LINGUISTICS

EFFECTS OF THE SECOND FORMANT IN THE PERCEPTION OF VELARIZATION IN LEBANESE ARABIC

(Order No. Mic 61-2052)

Dean Hubert Obrecht, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Leigh Lisker

In addition to the voiced-voiceless distinction in its consonantal system the Arabic language has a third category, "emphatic," which intersects with both the others. In articulatory terms the emphatic segments are characterized by pharyngeal-area constriction. The principal acoustic correlate of emphasis is a frequency lowering of the second formant.

This study seeks to verify the cue status of the second formant lowering in the perception of emphasis, and attempts to establish on the basis of the second formant the perceptual boundary between each emphatic consonant and its non-emphatic counterpart.

The experimental procedure made use of spectrographic evidence, followed by discrimination tests using synthetic speech as produced by the Pattern Playback developed at the Haskins Laboratories. These tests were based on regularized synthetic speech patterns employing second formant transition variations. The tests were submitted to native speakers for assignment of the synthetic phones into the velarized or non-velarized categories.

Results indicate that the frequency lowering of the second formant is a necessary and sufficient cue for the perception of velarization, or emphasis. However, the nature of this formant's behavior and contribution vary with the type of consonant and vowel over which emphasis occurs. With a stop consonant and a vowel with high formant-two

frequency the transitional segment is maximally effective. In the case of a vowel with low formant-two frequency the transition is of lesser separability and effectiveness, particularly with lateral and flap consonants. With these, one must say that discrimination depends mainly on movement of the entire second formant, corresponding to the highly conditioned vowel allophones occurring with velarization in real speech.

It was found that formant-two variations act in one way or another to cue the emphatic distinction throughout the system, irrespective of consonant types. Second formant information was found to excel noise frequency in discriminating /s̤/ and /s/, and this noise frequency was found in any case to be unreliable for the informants tested.

A typical second formant onset frequency for dental and alveolar emphatic consonants was found to be in the vicinity of 1200 cycles per second. A similar locus for non-emphatic consonants was found to be approximately 1800 cycles, corresponding closely to earlier findings for English. It was found that the bulk of formant-two onsets which led to velarized identifications lay between 1000 and 1400 cycles.

A supplementary finding indicates that the optimum transition duration for velarized stop identifications in Arabic is 70 milliseconds – somewhat longer than the figure of 50 msec which has been found for English stops. This appears to correspond to the greater articulatory adjustment required in Arabic.

Suggestions for further experimentation are offered.

Microfilm $2.75; Xerox $7.20. 152 pages.

A STUDY OF OLD ENGLISH WORDS FOR DEMON AND MONSTER AND THEIR RELATION TO ENGLISH PLACE-NAMES

(Order No. Mic 61-2054)

Robert Anthony Peters, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Harold S. Stine

Statement of Problem: A semantic and etymological examination of OE nouns for demon and monster; their Germanic cognates in ODan., ODu., OFris., OHG, OI, ONorw., OS, and OSw.; their grammatical variants, occurrence, and contextual meanings in OE poetry, prose, and glosses in print; and their relation to OE, ME, and NE place-names.

Procedure and Methods: A list of known and suspected OE words for demon and monster was compiled by cross-indexing all of the entries in the five major OE dictionaries and glossaries. OE personal names of evil beings included were Be(e)lzebub, Circe, Goliam, Gorgon, Grendel, Lucifer, and Satan. Kennings and heiti were excluded. An examination list of the printed matter comprising the corpus of OE poetry, prose, and glosses was prepared by cross-indexing the bibliographical and index references in N. R. Ker, Catalogue of Manuscripts Containing Anglo-Saxon (Oxford, 1957). Ker's authority was followed in accepting OE MSS dated later than c. 1100 for inclusion in the OE corpus except for the two early thirteenth-century MSS Worcester F.174 and British Museum Cotton Claudius D.III.

Results and Conclusions: Of the 132 OE words listed in OE dictionaries and glossaries as denoting or suspected to denote either demon or monster, twenty-five were found to denote neither: ælfen, āglǣcwīf, ceargest, dūnælf, dūnælfen, ellengǣst, *elwiht, faul, feldælfen, galdorgalere, gēosceaftgāst, grama, grīming, grundwyrgen, landælf, merewīf, muntælfen, orcŏyrs, sǣælfen, unman(n), unsceaft, wælcyrging, wæterælfen, wrōhtbora, wuduælfen. OE ?beorgælfen was not found in the OE corpus and apparently does not exist. Of the remaining 106 OE words, fifteen are of unknown origin, twelve are of non-Germanic origin, twenty are of Germanic origin, two are of probable Germanic origin, and fifty-seven are English formations. Twenty-two of the fifty seven words of English origin are single occurrence words, of which eight appear in glosses, ten in poetry, and four in prose.

Comparison of the writer's findings shows that seventy-five words in A Concise Anglo-Saxon Dictionary by J. R. Clark Hall, 3d.ed. (Cambridge, 1931) are erroneously or incompletely defined, six words are ascribed to the wrong gender, sixty-one headwords are incompletely or incorrectly spelled, and nine words examined by the writer are not listed. Similarly, eighty-four words in An Anglo-Saxon Dictionary by Joseph Bosworth and T. Northcote Toller (London, 1898) and Supplement by Toller (Oxford, 1921) are erroneously or incompletely defined, nine words are ascribed to the wrong gender, sixty-five headwords are incompletely or incorrectly spelled, and eleven words examined by the writer are not listed.

Thirty-two of the forty counties in England have one or more place-names containing or probably containing OE words for demon and monster. Derbyshire and Surrey rank first with thirty-seven each. There is no cluster of counties containing a large number of such place-names. However, the lower half of England contains twice as many such place-names as the northern half.

Examination of the dialectal characteristics of OE place-names of known location within a county and bearing a date of before 1150 did not yield any data that contributed to the further delineation of the four main OE dialect boundaries beyond that which is already known.

Microfilm $3.20; Xerox $13.30. 293 pages.

PHONETICS IN EARLY ISLAM: THE SPEECH-SOUNDS.

(Order No. Mic 61-870)

Khalil Ibrahim Hanna Semaan, Ph.D.
Columbia University, 1959

In the account most modern linguists give of the development of Linguistic Science, an important chapter is generally missing. That chapter is concerned with the contributions Semitic linguistic tradition, in general, and Arabic linguistic tradition, in particular, have made to the development of this science. The western student of linguistics, who, for the most part, has not had much incentive to inquire into developments of his discipline beyond its European and American tradition and environment, still believes that between the time Dionysius Thrax wrote his Latin grammar and the time when Lancelot's Latin and Greek grammars were published by the Jansenists of

Port-Royal-des-Champs, there was no progress in linguistic speculation and achievement. This Dissertation aims at correcting this notion by writing a part of the missing chapter, namely, that which deals with the role played by Medieval Arab grammarians in advancing linguistic thought, and with the achievements of these grammarians in the field of phonetics.

This study is divided into three parts:

1. An investigation of the stages of development of the Arabic linguistic tradition from the earliest known beginnings to the ninth century A.D. when the process of representing the speech-sounds of Arabic by written symbols was completed. This process went through three definite phases:
   a. an orthographical phase which was concerned with the problem of a set of signs which might be used to record accurately and intelligibly the sounds of the language;
   b. a grammatical phase, where grammarians were interested in the speech-sounds of the language as part of their descriptive analysis of the Arabic language; and
   c. a liturgical phase, where concern for the proper cantillation of the Qur'ān led to elaborate studies of linguistic phenomena.
2. An inquiry into the methods used by Medieval Arab grammarians in the description of the articulative aspect of the speech-sounds of Arabic and the categorization of the various types of these sounds. These grammarians described the articulation of the various speech-sounds of Classical Arabic in a quite similar way as modern linguists approach a similar problem. The early Arab grammarians recognized nearly all the phonemic categories of the Arabic speech-sounds.
3. An evaluation of the achievements of the Medieval Arab phoneticians in the light of our modern knowledge of the subject. The Medieval Arabs were not aware of the role played by the vocal cords in the production of speech-sounds. This fact made the phonetic works of the early Arab grammarians, despite its detailed accuracy, fall somewhat short of the results of modern linguistics.

The conclusion reached in this Dissertation is that "the contributions of Arabic writers on phonetics have every right to recognition, and to take their place in the history of linguistics, as this moves from the Greeks through the Renaissance to the modern period."

A model Arabic phonetic treatise is given in English translation at the end of the Dissertation. This particular treatise, entitled "A Risāla on the Points of Articulation of the Speech-Sounds," is by the famous Muslim physician and philosopher, Abū 'Alī ibn Sīnā, known to the West as Avicenna. Microfilm $2.75; Xerox $6.80. 143 pages.

LANGUAGE AND LITERATURE, MODERN

A HISTORY OF SELF-MADE MANHOOD: THE IDEAL OF THE SELF-MADE MAN IN NINETEENTH CENTURY AMERICA.

(Order No. Mic 60-5644)

John George Cawelti, Ph.D.
State University of Iowa, 1960

Chairman: Professor John C. Gerber

When Americans severed their political ties with England and founded a new republican polity, they felt the need of a new conception of manhood to replace the aristocratic gentlemanly ideal which had long dominated Europe. A new ideal, synthesizing the beliefs that each individual should find his own place in society, that social position should be in accordance with individual achievement, and that individual experience and understanding will lead men closer to truth than traditional institutions and authorities, developed in the late eighteenth century and its central image was the self-made man, then considered a uniquely American phenomenon. Benjamin Franklin, the first internationally known self-made man was the first widely popular expositor of a philosophy of self-made manhood, but ideas similar to Franklin's were widely expressed in the revolutionary period.

In the 1830's, 40's, and 50's, the ideal of self-made manhood changed under the impact of economic and social developments, but it remained a widely influential synthesis of political, social, and moral beliefs. Its influence can be seen on politics, on the development of educational ideas, and in many forms of literary expression, ranging from the popular didacticism of T. S. Arthur to the philosophy of Ralph Waldo Emerson. These highly various expressions of self-made manhood illustrate a wide variety of reactions to the fluidity and mobility of American society.

Although self-made manhood was a credo for both intellectuals and the common man in the Jacksonian era, a few Americans reasserted the traditional gentlemanly ideal in a new form, arguing that only through the persistence of a hereditary leisure class could many of the crucial values of civilization be preserved in a mass democracy. Among these critics of self-made manhood was James Fenimore Cooper who, though an acknowledged democrat in politics, rejected the idea of a totally mobile society. Cooper's criticisms were later echoed in such thinkers as Oliver Wendell Holmes, Sr., and Francis Parkman.

After the Civil War, and under the impact of rapid economic development, many of the political and moral conceptions which had once been a fundamental part of self-made manhood increasingly dropped away. The self-made man--once a symbol of the independent, responsible, and self-directing republican citizen--was transformed by the popular mind into the rugged entrepreneur in quest of fame and fortune.

Many Americans did not accept this new economic version of self-made manhood. Some, like Horatio Alger, continued to preach a sentimentalized version of the older ideal, ignoring most of the social and economic changes that were taking place. Among intellectuals, however, self-made manhood was frequently rejected altogether. Social scientists pronounced the ideal of free mobility a myth; reformers criticized individual competition as brutal and

immoral; keen observers of American life like Mark Twain and William Dean Howells showed that American society was in reality highly stratified. Toward the end of the nineteenth century, Henry James, in his novels and social criticism, presaged a characteristically twentieth century intellectual attitude toward self-made manhood when he emphasized the fulfillment of man's moral and aesthetic potentialities as far more important than the creation of opportunities for rising in society.

Microfilm $6.50; Xerox $22.95. 509 pages.

MASTER AND MAN: A STUDY OF CONRAD'S NOSTROMO.

(Order No. Mic 61-2201)

Roger Lindsay Cox, Ph.D.
Columbia University, 1961

Despite the great burst of interest in Conrad's novels, Nostromo has not received the attention and study which it deserves. Longer and more complex than any of his other stories, it reveals both the technique and the thought of Joseph Conrad more adequately than any other single work. The purpose of this study, like that of Robert Penn Warren's Introduction to the Modern Library edition of the novel, is to discover "what kind of book Nostromo is and what it means." Separate chapters of the dissertation are devoted to a summary of previous criticism, the major theme, related themes, characterization, structure, symbolism, and a new estimate of the book.

The title, formerly regarded as an unhappy choice on Conrad's part, illustrates the novel's density and "dramatic impenetrability." The role played by the titular hero is determined in part by the technical definition of of nostromo, the Italian word for "boatswain." Punning as it does upon the words "our master" and "our man," the title compresses into a single word the book's major theme, that of the relation between the one who possesses and the thing possessed, the imperceptible line between mastery and subjection.

Interwoven with Nostromo's main theme are several others that treat in detail certain aspects of the larger theme. Isolation of the individual person from the community of men, personal failure, the process of redemption, social "progress," political chicanery, imperialism--all the familiar Conrad themes--figure importantly in Nostromo. The advantage to the critic is that here these themes are presented within a single context. The success with which Conrad has interwoven them is an index of his achievement in this novel.

One of the most difficult problems in Nostromo criticism arises in connection with characterization, particularly that of Martin Decoud. Most critics tend to identify him with Conrad himself, and though he is a portrait of the artist as a young man, it is a gross oversimplification of the novel to assume that his role is for the most part a straightforward presentation of Conrad's mature point of view. The psychological interpretation of Decoud's role provides insight into the novel but tends to be misleading unless the other characters are regarded has having a similar function. Decoud is, to be sure, a spokesman for Conrad, but so are Monygham, the Goulds, the engineer-in-chief, and the others.

Structure and symbolism are the two most important aspects of Conrad's technique. In Nostromo he abandons the device of the single narrator such as Marlow and moves in the direction of a more genuinely objective structure, in which unity is achieved not by means of a dominant personality imposed upon the story but by structural parallelism. The epigraph reveals the model for the book's structure--Shakespearean drama. In a letter to his friend Cunninghame Graham, Conrad defines himself as a symbolist. Speaking of "Heart of Darkness" he says, ". . . I don't start with an abstract notion. I start with definite images and as their rendering is true some little effect is produced." Elusive as this process may be as a whole, Conrad employs techniques which lend themselves to analysis.

Like most other products of the human mind and imagination, Nostromo has certain significant faults. Some of these may be justified as being the direct result of important features of the book; others are impossible to justify from any point of view. Taken as a whole, however, Nostromo does what few other works of art can claim to do. It affords us the possibility of seeing the twentieth-century world, chaotic and disturbed though it is, as a meaningful and intelligible whole.

Microfilm $2.75; Xerox $9.00. 197 pages.

THE MIND OF THEODORE DREISER: A STUDY IN DEVELOPMENT.

(Order No. Mic 61-1456)

Joe Davis, Ph.D.
Emory University, 1960

Director: Floyd Watkins

The dominant characteristic of the life and works of Theodore Dreiser (1871-1945) was always a search for values, especially those moral and ethical values which usually emanate from strong religious beliefs. Cut off at an early age from those elements which shape and order the individual—religion, family, and traditional social concepts—Dreiser entered manhood a confused and disillusioned person. He felt that there was a fundamental dichotomy between appearance and reality, between the professed and the actual convictions of his fellow Americans. Although society demanded obedience to religious precepts which embraced stern moral and ethical codes, Dreiser felt that his neighbors were engaged in a bitter struggle for wealth and power which degraded and dehumanized the average citizen. Contemptuous of religions and what he thought was their conventional morality, Dreiser was always a humanitarian and a moralist. His basic sympathies were with those hapless individuals whose resources were pitifully inadequate for the demands of life.

A humanitarian and moralistic attitude are clearly demonstrated in his novels. In Sister Carrie and Jennie Gerhardt, Dreiser shows that love and happiness are frustrated by the materialistic, narrow conventionality of individuals and society. Carrie Meeber and George Hurstwood fail because they are essentially selfish, uncreative people. Jennie Gerhardt fails because the moral system of a conventional society does not allow for the pitiful circumstances of her life. In The "Genius" and "A Trilogy of Desire," Dreiser attacks the rapacious spirit of American

life, particularly in business enterprise. Such a system, Dreiser believes, thwarts the healthy, normal development of the individual by twisting his personality and debasing his character. Throughout his Trilogy, Dreiser lashes out at the titans of business for their selfish, brutal domination of the average, less fortunate citizen; moreover, he shows that Frank Cowperwood, though he gains tremendous wealth, is never satisfied or happy: wealth and fame are never enough, Dreiser concludes. In An American Tragedy, the controlling purpose is a diatribe against those forces in American life—notably narrow moralism and love of money—which crush and even destroy the weak, unsuspecting individual. Each of Dreiser's novels shows his immutable faith in the possibilities of the individual.

Dreiser's lifelong quest for some transcendental principle gives unity and meaning to the varying and often contradictory views in his novels. Explicit in each work is a powerful "love of life." More than anything else, Dreiser believed that experience was preeminently important to the sensitive individual. The greatest strengths that Dreiser possessed were those of intuition, emotion, and sentiment. He was particularly devoted to beauty—that of form, as in Nature and Art, and that of spirit, as in great men and noble women. The problems inherent in the individual's search for beauty—always a quest for the ideal, for the better thing—are the underlying themes of his novels. In each work, the major characters are involved in a search for some ideal which will make their lives meaningful and which will given them dignity and purpose. What, in effect, they seek are those qualities which usually emanate from religious idealism which alone can make life worthwhile and give it order and form and harmony.

In his last novel, The Bulwark (1946), Dreiser discarded his quasi-scientific notions and acknowledged that all phenomena, including man, are an expression of a transcendental Creative Force whose nature and purpose must remain unknown, but whose existence and power are manifest through the gift of love, which Dreiser defined as that Divine Force which enables all men who believe to live creative, happy lives in piety and equity with their fellow men and their world.

Microfilm $4.35; Xerox $15.30. 339 pages.

TIMES JOURNEY TO SEEKE HIS DAUGHTER TRUTH: AND TRUTHS LETTER TO FAME OF ENGLANDS EXCELLENCIE BY PETER PETT: A CRITICAL EDITION WITH INTRODUCTION AND NOTES.

(Order No. Mic 60-4919)

Robert Southmayd Davis, Ph.D.
The Claremont Graduate School, 1960

Times journey to Seeke his Daughter Truth: and Truths Letter to Fame of Englands Excellencie by Peter Pett was published in 1599, sometime between September 28 and January 15. Since then it has been overlooked by literary historians and condemned to the anonymity of handlists and catalogues; its author has fared no better. The present study, based on the unique copy now held by the Henry E. Huntington Library, offers a brief biography of the author, a critical and historical introduction to the poem, and a modern text.

The dedication to Charles Howard, Lord High Admiral, identifies the poet as a member of the Pett family, famous shipbuilders who rose to fortune under Elizabeth, ascended to the knighthood in the seventeenth century, and contributed meanwhile to the development of the British Navy from its shipyards in Chatham, Deptford, Limehouse, and Wapping. The founder of the family fortunes was Peter Pett of Deptford, who entered the naval service under Henry VIII and continued as master shipbuilder until his death in 1589. Three of his sons are concerned in this study: Phineas, whose autobiography provides biased first-hand information regarding the family's affairs and also provides an image of the rising Puritan middle-class with all its predisposition for moralized commercialism; Peter of Wapping, a son of Deptford's first marriage; and Peter the Younger, the prodigal son of Deptford's second marriage.

In asides to other studies, Times journey has been attributed to both Peter of Wapping and Peter the Younger. Details of the former's life are skimpy at best. We know that he was engaged in private shipbuilding at the family yard in Wapping and that he was a member of the Shipwrights' Company. There is no evidence that he matriculated at either university or that he held any office under the Crown. In all, he appears to have been a sober craftsman, engaged in private enterprise rather than literature.

External and internal evidence argues more favorably for attribution to Peter the Younger. From Phineas's autobiography we learn that he was born about 1580 and lived at Deptford until his father's death in 1589. Upon his mother's remarriage to the Rev. Thomas Nunn, he removed to Coney Weston in Suffolk, and upon her death in 1597 he was sent out to a "gentleman's house" where he served as tutor until 1599. At the Lent Assizes in 1599, his stepfather was found guilty of his sister's murder, and young Peter was taken to Phineas's home in Limehouse. There he remained until November 1599, when Phineas acquired for him a clerkship in the Ecclesiastical Court of the Arches. To Phineas's grief, young Peter left that position and took to "disordered courses." He died on June 21, 1600, at the Dolphin just outside Bishopsgate.

To this account of his life must be added a letter signed by Peter Pett and addressed to Sir Bassingbourne Gawdy, Berdwell Hall, Norfolk, and an entry in Philip Henslowe's Diary. The former apologizes to Gawdy for his delay and pleads prior commitments to Howard, whom he must attend at the court at Richmond; I attribute the letter to Peter the Younger, chiefly because he lived within an hour's ride of the Gawdy seat for ten years of his life. In his dedication to Howard, an allusion to the New Vagabond Act suggests that he is also the "mr Pett" who, with William Haughton, was associated with Henslowe and the Admiral's Men in 1600--about the time that Peter the Younger took to "disordered courses." Internally, the poem itself shows that the author is aware of the works of his immediate contemporaries, of the moral philosophy of the commonplace, of devotional literature and homilies. These elements of piety, combined with his compliments to Howard and his encomiums to Queen Elizabeth, suggest a young man of Puritan sympathies and Cavalier pretensions, who strayed from his brother's example and turned to the drama.

As art, his work is not always defensible, but as an image of a moment in religion and poetry, it is historically significant. To such literary models as Chaucer's House of Fame and Spenser's Faerie Queene, Pett joined the poetics of St. Paul, outlined in Ephesians 5:19-20, and basic

precepts of Calvinism, outlined in Book I of the Institutes of the Christian Religion. In narrative line, Times journey follows the vision tradition closely. Restless after a wearying night of study, the poet walks abroad, composes a brief meditation on man's ignorance of God's "hourely blessings," and hears a voice proclaiming the arrival of Time. He seizes Time's forelock and is borne aloft to the Palace of Fame, where Time hopes to hear of the whereabouts of his daughter Truth. Upon their arrival, they learn that Truth now resides in England, in proof of which, Fame reads "Truths Letter to Fame of Englands Excellencie." This portion of the poem praises England and Elizabeth for their defense of the True Religion and concludes with praises for England's "dauntlesse Warriours," whose numbers include his patron Charles Lord Howard.

The three basic images of the allegory belong to commonplace traditions found in emblem, pageant, romantic epic, and pulpit oratory. The seizure of Time's forelock objectifies St. Paul's injunction, "See then that ye walk circumspectly, not as fools but as wise, redeeming the time, because the days are evil" (Ephesians 5:15-16). His search for Truth and his discovery that she now abides in England illustrates a second commonplace theme--veritas filia temporis or Time as revealer of Truth--which resulted from a fusion of Greek and Latin proverbs with passages from the synoptic Gospels, and which had become traditional in the polemics of the period. His third basic image, which conveys Truth's misfortune under Queen Mary and her good fortune under Queen Elizabeth, is based on the War in Heaven and the fall of the Whore of Babylon (Revelation 12:7-9 and 17:16), both of which were traditional figures in the pulpit rhetoric of the period.

At odds with these polemics is his use of traditional themes found in encomiastic verse addressed to Elizabeth and her courtiers. The poem, then, lacks the unity of true art. At times courtly, at times pious, it reflects the divided nature of the poet's age and the poet himself. He was born too early to have been a thorough-going Puritan and too poor to have been a Cavalier. Inclining spiritually to the former, he aspired socially to the latter. In both inspiration and aspiration, he mirrors the disposition of his brother Phineas, of the middle class of his age, and the Puritan of the next century.

Microfilm $4.45; Xerox $15.75. 347 pages.

EDUCACION, NACIONALISMO Y PROPAGANDA EN LA LITERATURA DEL DR. JOSE RIZAL. [Spanish Text].

(Order No. Mic 61-1696)

José Felipe Del-Pan, Ph.D.
University of Southern California, 1961

Chairman: Professor Moreno

La obra literaria del Dr. José Rizal señala tres características esenciales: didacticismo, nacionalismo y propaganda. Las tres características se aprecian tanto en la prosa como en la poesía, pero se revelan más en la prosa. El interés didáctico resalta.

Rizal ansiaba la libertad y el bienestar de Filipinas, aunque apreciaba que la mayoría de sus connacionales eran víctimas de la ignorancia, mezclada con superstición y fanatismo. La iglesia era más poderosa que el estado, y en ella dominaban las órdenes regulares, ejerciendo gran influencia en las parroquias y curatos, hasta el extremo de que los funcionarios del gobierno español no podían muchas veces impedir las demasias de algunos clérigos de insuficiente preparación y mala voluntad. Con el tiempo el pueblo filipino manifestó su desgrado, en un principio dirigido contra los clérigos de las órdenes regulares, extensivo más tarde a cuanto significaba soberanía española en Filipinas.

Rizal, patriota ardiente desde muy joven, se propuso consagrar la vida a remediar el estado de cosas en Filipinas, logrando reformas por parte del gobierno español que impidieran los abusos, al propio tiempo que hiciera la reforma del sistema educacional en las islas con igualdad entre españoles y filipinos, aspiraciones que también compartían bastantes españoles, en especial los más cultos.

Rizal utilizó la pluma principalmente para lograr la elevación espiritual y material del pueblo filipino. Desde su adolescencia, como estudiante en el Ateneo de Manila, hasta su muerte, con excepción del tiempo de su destierro en Dapitan, no cesó luchar por Filipinas. En España y otros países de Europa colaboró en periodicos y revistas en favor de su ideal patriótico atrayendo la simpatía de otros jóvenes filipinos y del elemento liberal español. En Europa escribió Rizal sus novelas Noli me tangere y El filibusterismo, que tuvieron el exito de unir a los filipinos cultos y de elevar los pensamientos del pueblo filipino para la anhelada libertad.

Como la mayor parte de la obra literaria de Rizal se inspira en motivos patrioticos y es exposición del malestar en las islas, tiene marcado tinte de propaganda. Sin embargo, Rizal no creía que el pueblo estuviera preparado para la independencia y, por ello, prefirió defender un programa de reformas basado en cambios educacionales. En las publicaciones de Rizal, especialmente en Noli me tangere se halla un completo pensamiento pedagógico, filosofía educacional muy avanzada para su tiempo.

Rizal fue llevado por su ideal patriotico, en el deseo de unir islas y pueblos del archipielago filipino, hasta el campo del nacionalismo y de la independencia. Rizal creó un espiritu filipino, donde los tagalos, ilocanos, pampangos, visayas y demás grupos étnicos de las islas se integraban en un común sentido filipino, con inclusión de mestizos, criollos y hasta de chinos nacidos en las islas. Aunque el nacionalismo de Rizal no era extremista, si se manifestaba intenso, acaso por la calidad de poeta romántico del autor. Aunque no deseara Rizal que se llegara al conflicto armado, con el tiempo se produjo y en él quedó Rizal como mártir y apostol de la libertad de Filipinas.

El pensamiento pedagógico de Rizal se expone claramente en el capítulo XIX de Noli me tangere. Esta obra, considerada por la mayoría de los críticos y biógrafos como la mejor de las novelas del autor, es también de propaganda. El estilo rizalino es de estilo didáctico, vertiendo ideas y conceptos en diálogos platónicos.

Microfilm $2.75; Xerox $9.25. 201 pages.

SHAMANISM AND CHAMPAGNE: A CRITICAL INTRODUCTION TO THE VORTICIST THEORY OF WYNDHAM LEWIS.

(Order No. Mic 61-1487)

John Henry Edman, Ph.D.
Syracuse University, 1960

Supervisor: Donald A. Dike

This dissertation contains a general survey of the total literary achievement of the contemporary British artist Percy Wyndham Lewis, presented in as complete detail as is commensurate with the confines of one book. It concentrates especially upon the art theory of this satirical painter-novelist, as an individual thinker, as a Vorticist, and as a representative figure among classical artists of all time. The book is divided into five major sections: an introduction; a biographical sketch of Wyndham Lewis and his backgrounds; a discussion of Vorticist theory (the English branch of analytic cubism); an analysis of the application of theory to practice as manifested in Lewis' novels; and a brief discussion of the ends he hoped to achieve, primary among which was the construction of "a new human ethos" capable of making a healthy adjustment to life in the modern mechanized world--a life increasingly removed, detached and abstracted from primitive compulsions--and an ethos whose hope was to modify the anaesthetic effects provoked in modern man isolated from nature and radical instinct by the artifacts of technology.

Essentially, Vorticist theory is dualistic or pluralistic, and it is the equivalent in poetry and painting of Cartesian analytic geometry in mathematics. It begins with the assumption of "primal discord" or discontinuity at the very heart of things and systematizes the further implications of that assumption. Vorticist art is a stylized, methodized, idealized naturalism; but it is also an eclectic composite of the best techniques of classicism, romanticism and scientific realism. Its accents, furthermore, are primarily comic and epic, rather than tragic, even though it emphasizes the pain in paint, and is an art of angry young men. Its "grand style" is based ultimately upon the grandeur of noble Doric virtue, classical modesty and the "wisdom of humility."

Much of the dissertation is devoted to an analysis of Wyndham Lewis' polemics in favor of philosophical ephexis, peace in the political sphere, rationalism in religion, the greater enlightenment of mankind, the liberal extension of freedom of speech and thought in all areas of professional endeavor, and the rich, full, undisturbed, and uninvasive, "good life" in general. The ultimate burden of this dissertation is that the "Men of 1914" (as Wyndham Lewis called Ezra Pound, James Joyce, T. S. Eliot and himself) hoped that they were "primitives of a future equilibrium" which would reach a new plateau of human culture and materialize there a new Renaissance; but that subsequent history discouraged and disappointed them and proved them, frankly, wrong from the start.

Microfilm $7.40; Xerox $26.35. 584 pages.

A STUDY OF VALUES IN SELECTED PUBLISHED PROSE OF ELLEN GLASGOW

(Order No. Mic 61-318)

Herbert Weaver Edwards, Ph.D.
New York University, 1960

Chairman: Associate Professor James H. Hanscom

This study sought to derive from the major novels of Ellen Glasgow the values implicit therein and to relate these values to those explicitly stated in selected parallel critical and autobiographical writings to determine the relative degree of consistency between them.

Analysis of the writings for value statements was made inductively according to eight criteria: (1) motivation of character; (2) recurrent favorable traits in the central characters; (3) attitudes of the characters; (4) authorial comment on the characters; (5) moral and philosophical generalizations by the characters; (6) authorial obiter dicta; (7) plot resolution; (8) recurrent themes in successive novels. Parallel writings were analyzed in accordance with these criteria insofar as was relevant to the subject matter of non-fiction.

Classification of citations thus derived showed romantic love to be the primary value in the great majority of the novels, with the heroine as the value center in most, and the prospective marriage or reunion of a heroine and a worthy central male character as the chief determinant of the "happy ending."

However, it was found that this theme was subject to endless ramifications through the introduction of many concepts in the larger world of the author's values. Ten of these concepts are positive, such as the author's belief in innate superior traits of character and temperament, and in the recurring favorable traits of love of animals, love of nature, revolt against conformity, etc. (The leading favorable traits for both principals were listed in the appendix.) Eight are negative, such as the rejection of religious orthodoxy and of evasive idealism, the author's belief in pessimistic determinism, etc. Seven show a trend from positive to negative, such as the loss of faith in democracy, rejection of the effects of the rise of industrialism, increasing pessimism regarding human nature generally, etc. Nine show an ambivalence throughout, such as the possibility of happiness, class consciousness, and the origin, nature and reality of romantic love itself.

The plot is usually concerned with the relationship of two principals whose "good" qualities complement each other's and whose romantic attachment is favorably or unfavorably resolved, regardless of other themes or situations introduced. The "unhappy" endings are usually owing to the moral inadequacy of the central male character, although in some instances a female character is the cause.

There is a fair degree of consistency in value statements between the two groups of writings, the tone and subject matter of each group becoming increasingly serious and critical after 1925. Discussion of romantic love in the parallel writings was confined largely to a criticism of the sentimental myth of the "womanly woman," particularly in the South, with almost no reference to the author's novels as examples of a superior kind of love. Miss Glasgow's autobiography reveals the full force of her lifelong pessimism and tells of her own two experiences with romantic love, but makes little reference to the novels.

Conclusions drawn stressed (1) the diminishing effect of the concentration on romantic love; (2) moral ambiguities in the later novels; (3) effect of the omniscient author; (4) inconsistencies in the author's philosophical attitudes; (5) arbitrary manipulation of character traits and situations. Implications for further study appeared in the areas of (1) clearer correlation of the novels and the author's biography; (2) analysis of psychological problems relative to the handling of romantic love; (3) sources of the author's philosophical pessimism; (4) implications for democratic thinking; (5) for the student of social history. Microfilm $6.55; Xerox $23.40. 516 pages.

THE CRITICAL RECEPTION OF ARNOLD'S POETRY: THE RELIGIOUS ISSUE.

(Order No. Mic 61-1363)

Nelle Trew Francis, Ph.D.
The University of Texas, 1961

Supervisor: Dr. Oscar Maurer

All of the major critics who reviewed Matthew Arnold's poetry from 1849 (when the first volume appeared) through 1904 (when William Harbutt Dawson published Matthew Arnold and His Relation to the Thought of Our Time, the last critical work to represent the Victorian period) concerned themselves with the religious issue which the poetry raised. The criticism reflected the divergent attitudes of the critics toward religion and yet their preoccupation with the topic. It reflected, too, the changing temper of the times.

Arnold's poetry appeared in two decades at the middle of the century, 1849 to 1867, a period when orthodoxy still prevailed, though it was being strongly challenged. In the first years the religious questionings in the poetry brought strong disapproval from the critics and, consequently, less appreciation of the poetry itself. The journals of religious bodies, the North British Review and the English Review, for example, were wholly condemnatory. John Duke Coleridge in the Christian Remembrancer opposed the tendency of the poetry. Kingsley recognized the fineness of Arnold's talent but regretted the non-Christian purposelessness of the poetry. Clough declined in his review to sanction Arnold's position. Only Froude and William Michael Rossetti were genuinely sympathetic. The turning point came when Swinburne reviewed New Poems in 1867. He did what no other critic had yet done. He showed respect for the ideas in "Empedocles on Etna" and was generous in his praise of the whole volume. In later years critics referred often to this review. The immediate effect, however, was "guilt by association" with the pagan Swinburne. Further, a notable controversy arose over the question of the identification of Arnold with Empedocles. After 1867 Arnold published little new poetry, but from 1869 to 1888 five collected editions of his poems appeared.

In 1870 Arnold alarmed the orthodox religious world with the publication of St. Paul and Protestantism. The decade of the eighteen-seventies was devoted to religious controversy. Critical notices of the poetry increased. Arnold's most important critic who was an apologist for orthodoxy was Richard Holt Hutton, an intuitionist under Coleridgean influence. Notwithstanding the despair in the poetry, Hutton saw a resistance of spirit, a buoyancy, that was attractive to him. He believed that Arnold treated doubt paradoxically, yielding intellectually and abstaining morally. His favorable reviews are the best illustration of the fact that Arnold appealed to believers and unbelievers alike.

By 1880 interest in religion as a literary criterion began to abate. Arnold called the new current of thought a "lay current." The reviews of his poetry, appearing less frequently, were likely to be concerned with topics other than religion. Yet in 1888 after Arnold's death the obituary reviews returned to the religious note. Significantly, Arnold's poetry rather than his prose secured the attention of the reviewers as they considered his literary career. In the eighteen-nineties the critics, writing of Arnold because they found in the poetry that which illuminated their own thought, were clearly secular in their viewpoints. New movements in criticism--impressionism and New Humanism--began to be reflected in the reviews.

Through the years Arnold was well received by discerning critics in American periodicals, Henry James and John Dewey among them. Long before his two trips to America in the eighteen-eighties his American reputation as a major poet and critic had been established. This fact was the motivation for an important review by Leslie Stephen in 1893 on Stephen's return from America. Although he acknowledged Arnold to be a genuine poet, Stephen, an agnostic, was chiefly concerned with Arnold's religious position. He disliked Arnold's harking back to the old creeds if only in the form of spiritual regret in the poetry. He termed the performance "musical moans over spilt milk."

This survey of one hundred and forty-seven reviews and studies of Arnold's poetry from 1849 to 1904 has proved that of all aspects of the poetry the religious questionings attracted the most critical comment and that the shift in the course of criticism was parallel with a movement toward secularism in thought. This study has also thrown further light on the dominant importance of religious controversy in nineteenth-century literature and literary criticism.

Microfilm $4.40; Xerox $15.55. 342 pages.

A STUDY ON THE OLD FRENCH ROMANCE OF FERGUS

(Order No. Mic 61-2032)

Wilson Lysle Frescoln, Ph.D.
University of Pennsylvania, 1961

Supervisor: Professor William Roach

The Fergus is an Old French Arthurian romance in octosyllabic rimed couplets, written by Guillaume le clerc near the beginning of the thirteenth century. The subject matter, characteristic of the genre, is the adventures of a knight in the service of King Arthur; the action takes place in Scotland. The poem is preserved in two manuscripts in France, of which there are two nineteenth-century editions: one, extremely rare, is a faithful copy of the inferior manuscript, and the other now rare, an

unsatisfactory presentation based on the better manuscript. There is, then, a need for a new edition.

In the dissertation, the Fergus is examined in detail, considering the relatively scant scholarship devoted to the subject to date, the story and its relations to other works, its composition and narrative technique, the dialect and period of the author, and the geographical problems. Because of the need of a new and modern edition of the romance, I intend to publish a critical edition, incorporating much of the material of the dissertation into the introduction and notes.

It is shown that the works of Chrétien de Troyes which influenced Guillaume most are the Perceval, the Yvain, and the Erec, in that order. Probably the Bel Inconnu and the Second Continuation of the Perceval were also sources of the Fergus. However, it is not possible to prove any influence of the Fergus on later romances.

The power of characterization is exceptional, and the plot construction is carefully executed, especially in respect to the chronology of the narrative and the unity of motivation. The strikingly realistic passages are achieved by objective realism, psychological realism, and by suppression of the supernatural. The author seasons his work with occasional touches of humor and succeeds in keeping his complicated succession of episodes free from contradiction. Guillaume is a better conteur than a poet. His poetic mechanics is banal, and at times the verses are weak and contain poor rimes.

Guillaume le clerc has often been confused with other Guillaumes; actually the Fergus is his only known work. His dialect is Picard, but he uses many Francian forms in rimes. The relations to other works, the internal references, and the language place the date of composition early in the thirteenth century.

The romance contains twenty-four place names in Scotland, an unusual fact which has long caused critics to conclude that Guillaume knew the country at first hand. However, his errors in the location of large areas, his artificial forcing of local color, and his ignorance of climate and distances indicate strongly that he never actually visited Scotland. Also his treatment of one of the historical personnages tends strongly to show that the romance was not written under the patronage of a descendant of the historical Fergus, Alan of Galloway, as has been generally believed. The Scottish setting is the most original feature of the Fergus, one of the author's few original contributions, extending Arthurian literature and knightly adventure to a more remote and exotic setting.

Microfilm $2.80; Xerox $9.70. 213 pages.

TRADITION AND ORIGINALITY IN THE DRAMATIC WORKS OF JUAN IGNACIO GONZÁLEZ DEL CASTILLO

(Order No. Mic 61-2084)

Dennis Griffith Hannan, Ph.D.
University of Oregon, 1961

Adviser: Perry J. Powers

The present study seeks to define the contribution of Juan Ignacio González del Castillo (1763-1800) to the growth and development of Spanish drama in the eighteenth century. A study of this author's literary production is justified in view of its intrinsic worth and its historical significance; yet, despite his popularity with the Andalusian public and his contribution to the Spanish theater, no exhaustive examination of his works has heretofore been undertaken. This thesis attempts to fill the gap left by literary historians and critics of whom only one, González Ruiz, has seen in Castillo more than a regional dramatist, an Andalusian counterpart for the Madrid sainetista, Ramón de la Cruz.

The procedure here is to present Castillo as a transitional figure by bringing out in his plays the rôle of three distinct types of drama, Spanish drama of the siglo de oro, French classical works, and Spanish neoclassicism. In so doing this study presents a fresh approach to Castillo by pointing out the evidences of foreign influences in his works. A concluding chapter on his full-length plays indicates a movement from popular national drama to neoclassicism and preromanticism.

Castillo began as an exponent of the género chico but introduced into his domestic sainetes a fusion of foreign and national characteristics. In these short pieces his satirical themes and treatment indicate French influences but the literary form, prosody, and many of the social types demonstrate the force of Spanish dramatic traditions.

The most striking evidence of direct influence of foreign models in Castillo's sainetes occurs in La orgullosa enamorada which contains extensive imitation and adaptation of Le Legs by Marivaux.

Our playwright's three major compositions possess a spirit and form bearing little resemblance to the sainetes. In them Castillo appears as an experimenter and innovator with a cosmopolitan point of view. The neoclassical comedy La madre hipócrita, the neoclassical tragedy--or tragi-comedy--Numa, and the sentimental play Una pasión imprudente reflect the predominant literary currents of the time. The last reveals the influence of the comédie larmoyante, an essentially cosmopolitan genre whose only previous Spanish exponent was Jovellanos. However, it not only continues this form in Spanish drama but also adds features which later characterized the romantic theater.

In the final analysis, in his expansion from the sainetes to the full-length plays--the latter all composed within two years of his death--Castillo mirrors the conflicting Spanish and foreign tastes of his era, weaving a significant strand in the fabric of national drama in the course of his development as a playwright.

Microfilm $2.75; Xerox $7.20. 151 pages.

HENRY MORE'S PSYCHATHANASIA AND DEMOCRITUS PLATONISSANS: A CRITICAL EDITION.

(Order No. Mic 61-2212)

Lee Haring, Ph.D.
Columbia University, 1961

This is a critical edition of two of the philosophical poems of Henry More (1615-1687), Cambridge Platonist. Since the seventeenth century there have been one complete edition of More's poetry (A. Grosart, 1878) and one partial edition (G. Bullough, 1931) which did not include these poems. The present edition aims to supply a dependable

text of the two poems on the basis of modern textual procedure. More's Philosophicall Poems (Cambridge, 1647) has been used as copy text and has been compared with the first edition of each poem. Its accidentals have been preserved throughout. The basic copy used is one in the Columbia University Library. All variants among the seventeenth-century editions are recorded in textual notes.

The two poems were written between 1640 and 1647, without intention of publication. Psychathanasia presents neo-Platonic arguments for immortality, and denies the infinity of space; Democritus Platonissans affirms infinite space and time. For most of his ideas on the nature of the soul More drew on Plotinus, as he acknowledges in explanatory notes. The soul is neither extended nor material: its distinguishing characteristic is "energie"; it is self-animated; natural piety proves it divine; it is independent of the body; it is pre-existent. The third canto of Book III of Psychathanasia contains an exposition of the Copernican system of the universe. More derived his ideas on astronomy from a Latin translation of Galileo's Dialogo sopra i due massimi sistemi (Systema Cosmicum, Lyons, 1641). At the end of the poem he denies the infinity of space. Under the influence of Descartes' Principia Philosophiae (1644) More embraced the ideas of infinite space and time and expounded them in Democritus Platonissans. In the preface he takes issue with Descartes on the question of indefinite extension, having already formulated the objections developed in their later correspondence (1648-49).

The poems are finally of greater interest to students of intellectual history than to those seeking vivid allegory or metaphor. They represent a stage in the acceptance of "new astronomy."

Microfilm $4.80; Xerox $16.90. 373 pages.

ANTINATIONALSOZIALISTISCHE GESTALTEN IM DEUTSCHEN NACHKRIEGSROMAN. [German Text].

(Order No. Mic 61-1493)

John Kempers, Ph.D.
Syracuse University, 1960

Supervisor: Henry J. Groen

The unending stream of German newspaper articles, essays and books, dealing with the period of National Socialist rule, indicates that this period continues to be of great concern to the Germans. In novels as well, the attempt is made to come to terms with two basic questions: How was it possible for Hitler to come to power in 1933 with the support of a great part of the German people? How could he have stayed in power so long?

It is the purpose of this dissertation to ascertain how opponents of National Socialism are depicted in such novels. Some of these opponents may have rejected National Socialism from the beginning; others may originally have adopted a neutral attitude toward the movement or even supported it. A consideration of the prime reason for opposition led to grouping the characters in the following categories: I. Opponents for military reasons. Criticism of Hitler's strategy may lead to a rejection of National Socialism as a whole; an important consideration in evaluating these characters is whether they reject Hitler because he started the war or because he lost it. II. Opponents for political reasons. They may stand to the right of National Socialism or to the left. Communist novels form a special group here: their criticism of Hitler's dictatorship, true as it is in itself, loses its force because it can be applied with equal justice to that of Stalin. III. Opponents for personal reasons. As in I, the rejection may eventually achieve a broader basis or remain limited to considerations of personal hardship and discomfort. IV. Opponents for humanitarian reasons. The characters of this group do not think primarily or even at all of their own fate; they are concerned with the over-all effects of National Socialist rule, specifically with its influence on the German character. These opponents, impelled by high ethical motivations, leave a deeper impression, their sufferings and sorrows are compelling and convincing.

The novels discussed here advance many arguments in an attempt to explain the support given to Hitler by large sections of the German people before and after 1933. The responsibility of the Western Powers for Hitler's rise is often mentioned, sometimes with the obvious purpose of absolving the Germans of most of the blame.

The most frequently recurring reasons for the rejection of National Socialism are: Reichstag fire; Röhm affair; "Kristallnacht"; occupation of Prague; outbreak of the war; concentration camps; racial theories and treatment of Jews, Poles and Russians; laxity in applying laws to Party members; denunciation; scorn of tradition and of cultural values; reduction of Germany to a police state; Hitler's character, his method of waging war, and his contempt for human life (the name "Stalingrad" achieves symbolic significance here).

With the exception of characters in novels written by Communists, the opponents rarely translate their thoughts into action. Rather, they feel the need to dissimulate their true feelings and to choose, in everyday situations, the course of "the lesser of two evils." The four decisive reasons for inaction appear to be: 1. fear of the concentration camp; 2. impossibility of martydom: by letting its opponents disappear in mute anonymity, National Socialism deprives them of the possibility of setting an example for the whole nation; 3. uselessness of opposition well into 1942, as long as the greater part of the German people stood firmly behind Hitler; 4. after Stalingrad, the conflict between not desiring Hitler's victory and being fearful of Germany's defeat which ever more clearly implied the equally unwanted victory of Stalin.

Microfilm $3.20; Xerox $11.25. 246 pages.

COMMENTS ON ART AND LITERATURE FROM THE PERSONAL WRITINGS OF A GROUP OF WELL TRAVELED, EARLY AMERICAN WRITERS AND ARTISTS. A CRITICAL COLLATION.

(Order No. Mic 60-3313)

John Joseph Lawler, Ph.D.
The Florida State University, 1960

This dissertation is a critical collation, a presentation of quotations selected and organized for the purposes of analysis and comparison. The sources of this collation are the published journals, diaries and letters of a group of eight creative artists in three fields--literature, painting and sculpture--artists who were prominent, active and influential early in the Nineteenth Century. These early Romantic, pre-transcendentalist artists, who were personal friends and who traveled widely in the United States and Europe, are the following: William Dunlap, Washington Allston, Washington Irving, James Fenimore Cooper, Samuel F. B. Morse, William Cullen Bryant, Thomas Cole, Horatio Greenough.

The purpose of this study is to make easily available to both students and professional scholars the relatively informal and personal evaluations of and comments on artists and works of art of all periods. The material collated--selected, juxtaposed, and cross-referenced--consists of most of the comments on the arts in the published writings of the eight principals. This collation permits the reader to introduce himself to or to supplement his knowledge of the aesthetic climate of the early Nineteenth Century by examining primary sources many of which are not easily available. Tentative, conservatively expressed generalizations about the material are included in the introductions to the various categories.

The comments are organized by subject matter into four parts, each of which is divided into several categories. Part One includes comments on historical artists and works and is divided into conventional periods and centuries from Egyptian to late Eighteenth Century. Comments in Part Two are about contemporary European artists and works; those in Part Three are about contemporary American artists and works; those in Part Four are about the principals themselves.

The principals are consistent in their admiration of the rational in art and in their disinterest in or aversion for the emotional. They admire classical sculpture and architecture; and although they praise medieval architecture they are shocked by expressionistic medieval sculpture. Their comments on the Fifteenth to Eighteenth Centuries continue to indicate this rational, anti-emotional taste, with perhaps some exceptions. They prefer Raphael to Michelangelo, yet consider the Venetians the greatest school of painters. They praise the placid Claude Lorraine and Poussin, but also praise the more dynamic and emotional Rubens. Didacticism is frequently a deciding factor. They consistently react against baroque and rococo architecture and sculpture.

Among the most highly praised of contemporary artists are Coleridge, Scott, Benjamin West and Allston. In painting, the principals prefer the academic, didactic, yet coloristic British school to other styles. The comments on the principals by themselves and others vividly reveal some significant issues in their aesthetic lives: the easily motivated inaction of Irving; the dilemma of Cole's desires to be both naturalistic and didactic; the profound and tragic struggle of Allston to solve and complete his "Belshazzar"; the ambition, egotism and frustration of Morse; the seriousness and the contemporary critical reputation of Greenough.

Generally, the principals are extremely conservative and academic in their tastes in historical and contemporary art. Romantics themselves, they are yet suspicious of emotionalism in the arts and show practically no interest in the experimental and revolutionary men and works of their own or previous times. As a group they are a classic example of the transitional in art.

Microfilm $5.55; Xerox $19.60. 433 pages.

THE ARISTOCRAT IN THE SPANISH NOVEL OF THE NATURALISTIC PERIOD

(Order No. Mic 61-2147)

Herald Ernest Lewald, Ph.D.
University of Minnesota, 1961

This writer first examined the flow of naturalistic prose into Spain, a flow that was accompanied by exponents of positivistic-Darwinistic literature and which found a reflection in the literary circles of the time, including widespread comments in journals and magazines and numerous Spanish editions of Zola's novels. Furthermore this writer observed that this influx coincided with the rise of the Spanish realistic novel which for the first time was to take into account the social, political and economic structure of Spanish society and objectively single out its most urgent shortcomings.

Thereupon it became the aim of this thesis to measure the extent of the naturalistic-positivistic influence by making a detailed evaluation of novels by Spanish authors that present a critical mirror of Spanish society, especially in their appraisal of the upper classes, mainly personified by the Spanish aristocracy.

The novels that were considered representative of this literary tendency and which were selected to be evaluated in this thesis are in chronological order:

Pérez Galdós, Benito,	Doña Perfecta (1876)
López Bago, Eduardo,	La prostituta (1884)
Alas, Leopoldo,	La Regenta (1885)
Sawa y Martínez, Alejandro,	La mujer de todo el mundo (1885)
_____,	El crimen legal (1886)
Pardo Bazán, Emilia,	Los Pazos de Ulloa (1886)
Pereda, José de,	La Montálvez (1887)
Coloma, Luis,	Pequeñeces (1890)
Palacio Valdés, Armando,	La espuma (1890)
Pérez Galdós, Benito,	La loca de la casa (1892)
_____,	El abuelo (1897).

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

The examination of these works showed the imprint of Zola's thoughts, intentions and techniques, in varying degrees, especially in the field of social criticism. Following Zola's footsteps, these novelists have made an attempt to portray Spanish society, its traditions, mores and changes. These novelists have explored the moral and physical decay of this society, and have seen fit to blame the Spanish upper classes, especially the aristocracy, for the deplorable state of Spain in the last third of the Nineteenth Century.

Through a detailed account of the activities concerning the members of the Spanish nobility who appear in these novels emerges a bleak composite picture: The Spanish aristocracy in the latter part of the Nineteenth Century exhibited great moral laxity in political and financial matters. The noblemen also showed a total lack of concern for ethical behavior in his domestic relations and in the treatment of other social groups. Simultaneously, their adherence to values and mores that belonged to earlier centuries incapacitated them to participate in the progress of a modern, technological society to the point of making their presence an anachronism and a danger to the progressive-minded elements in Spain.

The novelistic presentation of the decadence and disintegration of the Spanish nobility was a singularly realistic enterprise in that it was based upon unmistakable signs of decay and unrest that had already permeated most phases of life.

In the absence of sociological studies on the role of the aristocracy in Spain in the latter part of the Nineteenth Century, the novels here examined have served the dual purpose of giving us a literary as well as a sociological view of an important segment of Spain's recent past.

Microfilm $3.85; Xerox $13.50. 297 pages.

GERARD MANLEY HOPKINS AND THE CRITICS

(Order No. Mic 61-1372)

Dorothy Elizabeth Hagman Parker, Ph.D.
The University of Texas, 1961

Supervisor: Oscar Maurer

Gerard Manley Hopkins' reputation has followed the familiar pattern of many poets – through obscurity, to limited interest, then sudden lionization by coterie poets, and finally to general appreciation for his merits. During this last stage, scholars have become interested in the problems surrounding Hopkins' work, problems which arise from the poet's peculiar position in the nineteenth century, from his fragmentary explanations of his innovations, and from his being influenced by Jesuit disciplines and Scholastic studies. Out of these problems five general areas of research have been formed: Hopkins' life, his philosophy, his prosodic theory, his place in literary history, and critical analyses of his poems.

Although publication of the letters, journals, and miscellaneous papers greatly benefited the biographers of Hopkins, the critics occupied with his philosophical and prosodic theories, found their work complicated by the appearance of these papers. Because the poet was not a systematic thinker, his theories are confused and occasionally contradictory. The misapprehension that he wished to erect a philosophical system is the central fallacy of Hopkins' studies. Examinations of inscape and instress in terms of the philosophy of Duns Scotus or The Spiritual Exercises are interesting in themselves and show that neither term is at variance with Hopkins' religious beliefs, yet these examinations produce no final definition of the terms, nor do they contribute to a practical understanding of the poems. Other critics, wisely, consider inscape and instress simply as coinages modified by the poet's early studies at Oxford, his reading of Scotus, and his living under the disciplines of his Order. That he meant them to be considered in a practical as well as in a theoretical sense is evident by his describing certain poetic techniques as the inscapes of poetry.

As fragmentary as his philosophical system is Hopkins' prosodic theory. In order to find a defining principle which would organize his scattered comments on metrics, critics have turned one of two ways: they point to Patmore's dipodic theory as the pattern on which Hopkins unconsciously modeled his ideas, or to Greek isochronous verse of which Hopkins gave an "Englished" interpretation in the Preface to his Poems. The weakness of both views is that the poet's theory is considered as a system isolated from the poems. Actually his intention here, as with the theory of inscape and instress, was that his system should serve as a description of his experiments.

A third group of critics dismiss Hopkins' theorizing altogether and regard his rhythm as the rhythm of prose. Hopkins himself described his verse as being the rhythm of speech "when rhythm is to be found in it." This effect is not achieved through the imitation of banal talk but through highly wrought lines and complex sound effects. A number of scholars have set themselves to examining these effects, considering them to be what Hopkins meant by the inscape of verse. They have discovered the influence of Welsh, Greek, and Anglo-Saxon verse on Hopkins' poems. Other studies show a variety of resemblances between Hopkins and a great number of English poets, but the relations they point out are more incidental than integral and serve only to place Hopkins in literary history.

This general examination of the main themes of criticism on and research on Hopkins demonstrates, first, the mistake of considering his theory and poetic practice as isolated studies; and, second, the error of assuming that Hopkins had created either an aesthetic or a prosodic system that would explain all his innovations. In the end, the most profitable studies are those which give minute analyses of the individual poems, drawing from them what generalizations can be made, even though these generalizations may not always conform to the explanations Hopkins made of his own work.

Microfilm $3.10; Xerox $10.80. 240 pages.

A CRITICAL EDITION OF THE ROMAN DE THEBES (LINES 1-5394), WITH AN INTRODUCTION, NOTES, AND GLOSSARY.

(Order No. Mic 60-4862)

Dana Phelps Ripley, Ph.D.
The University of North Carolina, 1960

Supervisor: Urban T. Holmes, Jr.

This is an edition of manuscript C (late thirteenth century), B.N. fs. fr. 784, f. lv-67r., ll. 1-5394. The manuscript is reproduced exactly as it exists, changes being made only to correct minor errors which would impede reading. The corrections are indicated on each page, changes being supported by variants from the other MSS: B, B.N. fs. fr. 60; S, British Museum Add. 34, 114; A, B.N. fs. fr. 375; P, Phillipps 8384; D (fragment), B. d'Angers no. 26.

The Introduction of forty-two pages is concerned largely with the nature and dating of the genesis of the poem and its place in the development of the romance form. A new conception of the composition is established, especially in regard to the prototype (or lost original version), the poem which L. Constans attempts to reconstruct in his edition. It is concluded that the Thèbes in the form found in the extant versions was written slowly in an evolutionary process extending over a considerable length of time, perhaps five years for the earliest versions, those of MSS C, B, and S. The first versions were probably composed in the 1150's; if a prototype existed, it was undoubtedly shorter than these versions. During the evolutionary period of composition, many revisions and amplifications were made. Such a genesis is similar to that of the Rou of Wace, and there are other examples both in Latin and Romance of poems written in this manner. The Thèbes had probably reached ten thousand line length (as it appears in the earliest versions) by 1160 when it is mentioned in the opening lines of the Rou. The poem passed through a second period of amplification later in the century, perhaps in the fourth quarter; this stage in the evolution is seen in MSS P and A where the poem reaches fourteen thousand lines. The existence of these two periods reveals a parallel in development between the Thèbes and two other long romance poems of the twelfth century, the Roman d'Alexandre and the Roman de Troie. The decasyllabic Alexandre and the Thèbes have extant versions written near mid-century in a very carefully and finely made poetry, versions later expanded to much greater length. There is evidence that the Troie had a similar version close to the first Thébes in date. The Thébes differs from the decasyllabic Alexandre, however, in being carried to full size and completed form. It appears to represent thereby a transition from the mid-century period in which the first romance poems were carefully made on a small scale and the later blooming period when the earlier poems were amplified to fifteen and thirty thousand lines. MSS C, B, and S represent, probably, both the incomplete first versions and periods of amplification and revision; it seems doubtful that a prototype of the poem existed contemporary with the Alberich fragment.

For a poem having a genesis of this sort, a reconstruction of the first version is an extremely difficult undertaking. It is impossible to determine in many cases the oldest parts of the poem, and the result is uncertain and limited in scope. A basic edition should be made from the best MS in the early group (CBS) in order that it may portray completely the evolutionary genesis in its first versions.

Other significant parts of the Introduction are an analysis of the language and scribal features of MS C, summaries of the important background studies, and a full table of rhymes. Attempts to identify the author and to locate the poem geographically yield little in the way of new findings. The Glossary is selective.

Microfilm $3.45; Xerox $12.15. 267 pages.

THE ORIENTAL INFLUENCE IN JOHN GOULD FLETCHER'S POETRY

(Order No. Mic 61-1351)

Edna Buell Stephens, Ph.D.
University of Arkansas, 1961

Acutely conscious of the loss of integrity and order in the modern mind, John Gould Fletcher early turned to the Orient in an effort to construct a tradition, a new poetic convention for himself. As a student at Harvard, he dedicated himself to the task of fusing East and West, of combining the insight of the Orient with the energy of modern America: he thought such fusion might lead not only to a new poetry but also to a world religion.

In Irradiations: Sand and Spray (1915), Fletcher evidently drew upon his subconscious for his poetry, in the attempt to achieve the integrity so highly lauded by the ancient I-Ching. In Goblins and Pagodas (1916), he continues his quest for wholeness by incorporating into his poetry the Zen doctrine of the interdependence of man and nature, using the techniques of the Sung poets and painters. Using much Zen and Taoist symbolism, in the Symphonies he attempted to create mood by the use of color.

Japanese Prints (1918) represents Fletcher's attempt to fuse the spirit of the haiku into his poetry: he made great use of the season word and conventional imagery, and achieved great intensity. The Tree of Life (1918) shows a decline in Oriental imagery and idea: perhaps the disintegrating effect of Fletcher's relation with his first wife is here reflected symbolically.

Breakers and Granite (1921) fuses Zen and Taoist symbolism with American landscape as a symbol of the unity the machine has destroyed. Fletcher again uses the aesthetic principles of the Sung painters.

Parables (1925) begins Fletcher's religious period, marked by an upsurge of the Hindu element. His theme is the paradoxical unity of the warring opposites. Branches of Adam (1926) retells the Biblical story of the Flood, using such Hindu symbolism as the Eagle and the Serpent to advance his thesis that Reality consists of the reconciliation of opposites. In The Black Rock, Fletcher's God is similar to the Hindu Brahman transcending all opposites. XXIV Elegies (1935) deals with the Two-in-One aspect of Reality; one poem uses much Zen and Taoist symbolism, as the early books do.

Fletcher's last two books, South Star (1941) and The Burning Mountain (1946), belong to his regional period. South Star advances the Confucian ideas of deliberate tradition and the Superior Man, using regional imagery. The

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

Burning Mountain uses regional imagery to advance Taoist and Zen ideas. Fletcher's final word is that "repose in strife" is to be found in the love of nature. Thus to a remarkable degree Fletcher has achieved in his poetry his ideal of integrity.

The dissertation is important in Fletcher's biography in revealing for the first time the extent and pervasiveness of the Oriental in his thinking, in the exegesis of his poetry in revealing the thought of whole poems and the meanings in their images, and in the evaluation of his work in revealing heretofore unnoticed relationships among the elements of his poems which give them their high degree of artistic integrity.

Microfilm $4.25; Xerox $14.85. 330 pages.

SPACE-TIME IN JAMES JOYCE'S THOUGHT: A STUDY OF THE ROLE OF THE ARTIST IN HISTORY.

(Order No. Mic 61-1503)

Allan Thomson, Ph.D.
Syracuse University, 1960

Supervisor: Donald A. Dike

The purpose of this study is to find out what James Joyce thought about the artist's role in history. Space-time concepts are used as the controlling theme. Time is defined as time-structured history and as cyclical history. Space is examined in its metaphysical sense as used in the construction of mythic and religious cosmologies. Five of Joyce's works are studied: Drama and Life, James Clarence Magnan, Stephen Hero, A Portrait of the Artist as a Young Man and Ulysses.

Within the space-time framework specific conflicts arise that the Joycean artist must face. They consist largely of violent oppositions in two ways of looking at life and art. Among these opposites are determinism as opposed to free will, individual creativity as opposed to the slavery of the traditions of Church, state and family, the "here-and-now" as opposed to the "beyond," the "realities" of life as opposed to theological abstractions, and the world-as-nature opposed to the world-as-history. In seeking to overcome these ambivalences, Joyce's ideas show affinities with Giordano Bruno's theory of contraries, and with Giambattista Vico's views on the importance of poet, myth, language and the "ricorsi" theory of cyclical history. Likewise Joyce's thinking shows affinities with Henri Bergson's views on simultaneity, duration and the importance of the inner life as a source of truth, and with Ernst Cassierer's thinking on the structure and meaning of myth in the spiritualizing and universalizing of life.

Joyce's conception of reality unites language, myth, universal history and social fact into a consubstantial relationship through the symbolic-word. Joyce does not distinguish between the objects that he is describing and the words used to describe them. Mind as a source of memory and imagination unites with the soul to produce the creative forms which are the extent of man's knowledge of the uni--verse. Mind is a reality equal with other "things," and the soul is a living "spiritual principle."

Joyce reveals in Ulysses the vast space-time structure of myth, universal history, Bergsonian time and the everyday Dublin environment in which the artist must function. He must, through a resolution of his own oppositions, achieve a self-identity before he can create. His life must be constructed on what he may become, as well as what he is. This is done through the act of creativity born in the soul which resolves past, present and future into a universal vision of life. In transcending self as ego, he brings about (1) a spiritual renewal of the nation, (2) the synthesis of forms through his creative logos, (3) the immortalizing of himself and the hero--the doer of deeds, and (4) the spiritualizing of a universe stripped of its old religious and mythic meaning. He is himself a mythmaker.

The study also seeks to show: (1) that from evidence in his work, Joyce could have known Vico as early as the Magnan essay, (2) that from the Magnan essay to Ulysses there are in his views of the poet, ideals and purposes which remain unchanged, (3) that his own spiritual saga is closely identified with those of Stephen Hero and Stephen Dedalus, (4) that Joyce possessed a strong prophetic feeling and a desire for human betterment, (5) that his concern for Vico is more for his spiritual meaning than for the historical cycles, (6) that Joyce is not a Bergsonian in the manner Wyndham Lewis claims, (7) that in Ulysses, Joyce had already arrived at his views on universal history, spiritual progress, the conflict of opposites and the affirmation of the creative artist which were to be major themes developed in Finnegans Wake, (8) that an understanding of the dualistic structure of Western thought is essential to a comprehension of Joyce's novels.

Microfilm $4.75; Xerox $16.90. 371 pages.

THE IDEA OF NATURE IN THE POETRY OF WILLIAM BLAKE

(Order No. Mic 61-2225)

Louis Addison Waters, Jr., Ph.D.
Columbia University, 1961

Blake, unlike most English poets, mistrusted nature. Yet he was sensitive to its beauties, and, as a poet, could hardly avoid nature imagery. The resultant conflict profoundly affected his poetry.

Blake's attitude toward nature was chiefly the consequence of his being a visionary. He believed that he beheld in visions the spiritual agents behind natural appearances. There are four levels of vision in his system: the lowest, single vision, assumes the reality of the world of the senses; twofold vision regards sense-objects as symbols of spiritual realities; threefold vision attains imaginative understanding through love; finally, fourfold vision enjoys intuitive knowledge through spiritual identification.

Because vision was primary to Blake, nature at best could be but secondary. He evolved an idiosyncratic philosophical idealism in which the world that each man sees is the product of his beliefs and level of vision. The real universe is conceived as a spiritual Cosmic Man, fallen into disunity through the conflict of his "Zoas," or psychological faculties. Because of this fall, the usual world of appearances is evil, although nature is holy if seen as it should be by the unified creative imagination. Most often, however, Blake regards nature with ambivalence: as lovely and fascinating, yet cruel and delusive, associated both

with "natural religion" or deism and with feminine wiles and domination.

Nature images in Blake's poetry, from the Poetical Sketches onward, show a progressive tendency to associate on the basis of emotion or spiritual state. Seven such states may be distinguished, each with its characteristic images: (1) Innocence--spring, morning, green, lamb, songbirds and small creatures, fields, hills and valleys; (2) Sex--silver, moon, flowers, twined branches, fruit, garden; (3) Energy--summer, noon, fire, red, wild animals; (4) Imagination--autumn, gold, sun, eagle, harvest and vintage; the two aspects of (5) Experience (often conjoined)--(6) Deceit: twilight, black, serpent; and (7) Constraint: winter, white, cold, iron, night, stars, mountains, rocks, caves, predators, trees and roots, water. Some of these image clusters evolved into symbolic persons: the Constraint group, e.g., became embodied in Urizen.

In the Songs of Innocence, gentle pastoral imagery predominates, whereas most of the images in the Songs of Experience are drawn from the hostile aspects of the natural world. The "Minor Prophecies" are marked by increased didacticism and an elaborate symbolic system that verges on stereotype. Some images are taken from the Energy group, but those of Experience predominate. The same is true of Milton, in which most natural images are purely allegorical, although a few passages reflect Blake's close observation of nature during his residence in the Sussex countryside. In Jerusalem Blake's attitude toward nature is strongly antagonistic, and his use of nature imagery is restricted and perfunctory: the usual landscape is one of monotonous gloom.

Blake's increasing hostility toward nature eventually vitiated his natural description. His typical nature imagery --general, symbolic, and limited in range--soon became repetitious and mechanical. Yet much of the excellence of his earlier poems, before the doctrinaire overwhelmed the poet, sprang from imaginative identification with the life of the natural world.

Microfilm $2.90; Xerox $10.15. 224 pages.

JAMES GOULD COZZENS AND THE PROFESSIONAL MAN IN AMERICAN FICTION

(Order No. Mic 60-6754)

William George Wiegand, Ph.D.
Stanford University, 1960

This study analyzes the art of James Gould Cozzens by focusing on his characterization of "professional men" and by relating these to the mythos of professional types manifest in earlier American novels. What distinguishes Cozzens from his contemporaries is not his structural skill, or his "ideas," or his prose. His contribution to American fiction depends rather on his use of what may be defined as complexes of manners. In the eighteenth and nineteenth centuries, particularly in Europe, the depiction of manners lay at the core of the novelist's art. What American fiction has consistently lacked in the past, according to Lionel Trilling, is a "notation of manners . . . of class traits modified by personality." By his emphasis on the professions, Cozzens has found a useful analogue to "class." In his novels The Last Adam, Men and Brethren, The Just and the Unjust, Guard of Honor, and By Love Possessed, he has shown that the personality of his professional men reflects patterns observable in earlier creations of professional men in our fiction.

The study comprises four sections: on the doctor, the clergyman, the lawyer, and the soldier. In each of the chapters a number of prototypes are isolated for their significance to American fiction in general and their relevance to Cozzens' personnel in particular. In the chapter dealing with the doctor, I examine two prototypical patterns: that of the "angel-demon" doctors who derive from the Gothic novel and who recur in the fiction of Hawthorne and Robert Herrick; and that of the doctor as "code-hero" who emerges in the works of Jewett, Howells, S. Weir Mitchell, and Sinclair Lewis. Both these patterns are evident in Cozzens' George Bull, the doctor-hero of The Last Adam.

The Calvinistic protagonists of Hawthorne, Melville, Harriet Beecher Stowe, and Margaret Deland on one hand, and the Social Gospel heroes of Charles Sheldon, Winston Churchill, Henry Adams, and Harold Frederic on the other provide the chief clerical types traced in Chapter III. No less important to an understanding of Cozzens' work are the clergyman as "muscular Christian" and as sex neurotic. Cozzens' failure, in Men and Brethren, adequately to define the Calvinistic complex of manners over and above his hero's sentimental allegiance to its codes, weakens the portrayal of Cozzens' central character in that novel.

Cozzens uses lawyers importantly in his three most recent books. The prototype of the "courtroom wizard" is traced from the legends of the young Lincoln through novelists like Eggleston, Mark Twain, and Dreiser. A second prototype, that of the "chorus lawyer," the detached observer and commentator, is found earlier in Melville's "Bartleby," Cooper's Ways of the Hour, and in the novels of Wharton and Faulkner. In Cozzens, both types are reflected in his treatment of Judge Coates (The Just and the Unjust), Colonel Ross (Guard of Honor), and Arthur Winner (By Love Possessed).

At least four significant paradigms of the professional soldier are effectively integrated in Guard of Honor, Cozzens' finest novel. General Beal combines all the "typical" traits of his profession: those derived from the rank-conscious officers of Cooper's Pathfinder and Melville's "Billy Budd"; from the "flawed" officers of DeForest and Crane; the faceless officers of the Dos Passos-Hemingway generation; and the neurotic officers chiefly found in the works of post-war novelists like Heggen, Mailer, Wouk, and John Cobb. By interfusing, in his portrayal of Colonel Ross, a complex of manners from a different profession (the lawyer's), Cozzens has enriched Guard of Honor much as the depiction of diverse social patterns permanently enriched the work of Austen and Stendhal, of Balzac and Tolstoy and Thackeray.

Microfilm $4.45; Xerox $15.55. 345 pages.

DYNAMICS OF AN ELASTIC-BINGHAM BODY

(Order No. Mic 61-1853)

Willard Phillips Acheson, Ph.D.
University of Pittsburgh, 1961

Supervisor: A. M. Bryson

The elastic-Bingham model is proposed to characterize materials having both yield and visco-elastic properties. It comprises an elastic element in series with a parallel combination of a friction and a viscous element. Such a model may describe elastic, plastic, and viscous effects at once without resort to multiparameter systems. Static characteristics and the response to one-dimensional impulse waves are shown to be of a dual nature, purely elastic below yield and qualitatively similar to a Maxwell body at stresses large compared to the yield stress. In the case of torsional oscillations of a cylinder, the equation of motion for the plastic regime is found to be a second order, non-linear differential equation. The theory in this case is a natural extension of the theory of perfectly plastic solids, and the problem of torsional oscillations of a perfectly plastic solid cylinder is solved as a special case by means of the energy integral. For stresses below yield the usual equation for elastic oscillations is valid. Two approximation methods for solving the non-linear equation are pursued. The equation may be made linear and solved by elementary means by neglecting a term of the order of $e = \omega^2\theta_*/3$, where ω is the angular frequency of elastic vibrations and θ_* is a yield parameter. The first approximation method of Kryloff and Bogoliuboff is also used giving results accurate to within terms of the order of e in the solution. These solutions indicate that the motion is approximately a damped sinusoid with period twice the elastic period and a decrement proportional to the relaxation time when the motion carries over appreciably into the plastic regime.

Microfilm $2.75; Xerox $3.00. 55 pages.

CERTAIN IDEALS IN ALGEBRAS OF EXTENDED REAL-VALUED FUNCTIONS

(Order No. Mic 61-2455)

Howard Banilower, Ph.D.
Purdue University, 1961

Major Professor: Melvin Henriksen

A Φ-algebra is an archimedean lattice-ordered algebra with a multiplicative identity element that is a weak order unit. The ring C(Y) of all continuous real-valued functions on a topological space Y is a Φ-algebra, but not every Φ-algebra is isomorphic to an algebra of real-valued functions. However, M. Henriksen and D. G. Johnson (On the structure of a class of archimedean lattice-ordered algebras, Fund. Math., to appear) showed that every Φ-algebra A is isomorphic to an algebra of continuous functions on some compact space into the two-point compactification of the real line that are real-valued on a dense subspace. Such functions are called extended real-valued functions, and the compact space in question is $\mathcal{M}(A)$, the space of maximal ℓ-ideals of A with the Stone topology.

We restrict our attention, for the most part, to Φ-algebras that are uniformly closed in the sense that every cauchy sequence of elements converges. Henriksen and Johnson proved that if A is a uniformly closed Φ-algebra, then A^*, the subalgebra of bounded elements of A, is isomorphic to $C(\mathcal{M}(A))$.

We call an ideal I of a Φ-algebra A an F-ideal if for every $f \in I$, there is a $k \in A$ such that $f = k|f|$. In case $I = A = C(Y)$, for some completely regular space Y, this concept was introduced by L. Gillman and M. Henriksen (Rings of continuous functions in which every finitely generated ideal is principal, Trans. Amer. Math. Soc. 82 (1956), 366-391). They showed that for C(Y), this condition is equivalent to several others; for example, C(Y) is an F-ideal if and only if every finitely generated ideal of C(Y) is principal. They called a space satisfying these equivalences an F-space.

In Chapter 1, we show that many of these equivalences can be extended to F-ideals of an arbitrary uniformly closed Φ-algebra A. We also prove that the maximal F-ideals of A are in a natural one-one correspondence with the maximal F-ideals of A^*. Since A^* is isomorphic to $C(\mathcal{M}(A))$, the problem of investigating the maximal F-ideals of a uniformly closed Φ-algebra reduces to the study of the maximal F-ideals of C(X), for an arbitrary compact space X.

This latter problem is what we consider in Chapter 2. Our approach is to relate the maximal F-ideals of C(X) to the topology of X. We give an example of a compact space whose ring of continuous functions does not have a unique maximal F-ideal. For any compact space X, we define two ideals, $\underline{K}$ and $\overline{K}$, in terms of the topology of X and show that for any maximal F-ideal K of C(X), we have $\underline{K} \subset K \subset \overline{K}$. Also, sufficient conditions are given for $\underline{K}$ and $\overline{K}$, respectively, to be the unique maximal F-ideal of C(X).

Recall that an ideal I of a ring A is regular if for every $a \in I$, there is an $x \in A$ such that $axa = a$. In case $I = A = C(Y)$, for some completely regular space Y, L. Gillman and M. Henriksen (Concerning rings of continuous functions, Trans. Amer. Math. Soc. 77 (1954), 340-362) call Y a P-space and prove a number of equivalences for P-spaces.

Chapter 3 is in many ways analogous to Chapters 1 and 2. Our results are for a uniformly closed Φ-algebra A that

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

is closed under ℓ-inversion. This latter property assures that certain elements of A are units. We give several characterizations of the regular ideals of A, generalizing the afore-mentioned result of Gillman and Henriksen concerning P-spaces.

Unlike the analogous situation for F-ideals, B. Brown and N. M. McCoy (The Maximal regular ideal of a ring, Proc. Amer. Math. Soc. 1 (1950), 165-171) proved that every ring has a unique maximal regular ideal. For the remainder of this chapter, we investigate the maximal regular ideal M of A, and relate it to the topology of $\mathcal{M}(A)$. Two ideals of A, $\underline{M}$ and $\overline{M}$, are defined topologically, and we prove that $\underline{M} \subset M \subset \overline{M}$. Moreover, for the particular case where A is isomorphic to C(Y), for some space Y, we have $M = \overline{M}$.

Microfilm $2.75; Xerox $3.00. 60 pages.

AVAILABLE SOIL MOISTURE AS A STOCHASTIC PROCESS

(Order No. Mic 61-2298)

Dale Edward Cooper, Ph.D.
North Carolina State College, 1961

Supervisor: David Dickenson Mason

The objectives of this study were to characterize available soil moisture as a stochastic process and to study the probability distribution function of available soil moisture. The concept of the soil as a storage system allows the use of probability theory of storage and queueing systems. Four possible models are proposed relating available soil moisture as a time dependent stochastic process based on the evapotranspiration method of estimating soil moisture conditions.

An approximate solution to the probability distribution of available soil moisture is obtained by defining a finite number of discrete soil moisture states ranging from zero to storage capacity which satisfy the properties of a Markov chain. The stationary state probabilities are obtained by solving a system of equations in terms of the transition probabilities.

Two approximations are proposed for obtaining the transition probabilities from the distribution function of the input variable which is directly related to the frequency function of precipitation. The frequency function of daily precipitation was studied for 25 years (1928-1952) of North Carolina weather station records; following the Pearson system of curve fitting, the gamma distribution was found to give the best fit when compared with the log normal distribution and other curves in the Pearson system.

Frequency curves representative of the probability distribution function of available soil moisture were obtained for the case when precipitation is the only time dependent climatic variable involved in the soil moisture model. The results are in agreement with other storage and queueing systems; i.e., when the expected change in the system per time period is less than zero the probability tends to be concentrated at the origin and when the expected change in the system is greater than zero, the probability tends to be concentrated at the storage capacity.

Practical application of probable soil moisture conditions lies in evaluating the expected value of soil moisture variables in crop production functions. Several examples are given to illustrate areas where farm manager decisions could be made more nearly rational by making use of soil moisture probabilities.

Microfilm $2.75; Xerox $4.80. 91 pages.

MIXTURES OF STOCHASTIC PROCESSES

(Order No. Mic 61-1988)

David A. Freedman, Ph.D.
Princeton University, 1960

This paper is concerned with stochastic processes: the probabilistic abstraction of random experiments which have duration. Specifically, it deals with binary experiments, in which the outcome of the first experiment determines which second experiment (out of a pre-determined possible family) will be performed. The basic question is how to get information about the first experiment by observing the results of the second.

In particular, it is shown that one realization of the binary experiment does not yield any information about the first experiment; on the other hand, under certain conditions, complete information about the first experiment can be obtained by repeating the binary experiment often enough.

Special techniques are developed for two cases: where the predetermined family of second experiments gives rise either to Poisson Processes or to Markov Processes. In the Poisson case, the following problem is considered: decide between the alternatives

case H: The first experiment always selects the same second experiment

case A: The first experiment selects second experiments according to a non-degenerate probability distribution;

in case H, find which second experiment is selected; in case A, find the distribution.

In technical language, there is given a fixed base space $(\mathcal{X}, B(\mathcal{X}))$, on which is defined a stochastic process $\{X_t : t \in T\}$, and a family $(P_\lambda : \lambda \in \Lambda)$ of probability measures in $\mathcal{X}$. Λ is itself a measurable space, and P_λ is a measurable function of λ. P_λ may be integrated with respect to any probability measure μ in Λ.

It is shown that λ is identifiable if and only if μ is. Structural descriptions of mixtures of Poisson and Markov Processes are obtained. In the Poisson case the following decision problem is considered. The parameter space is the class Ω of all probabilities in Λ. The hypothesis set H is the set of elements of Ω with carriers of one point. The alternative set is $A = \Omega - H$. Consistent and asymptotically parameter-free size-α tests are developed for H vs. A, as well as consistent and asymptotically unbiased estimates for λ and μ.

Microfilm $2.75; Xerox $4.20. 79 pages.

MATHEMATICAL RESEARCH IN LATIN AMERICAN UNIVERSITIES

(Order No. Mic 61-2233)

Walter Laurie Furman, Ph.D.
The University of Florida, 1961

This study is a survey of contemporary mathematical research in Latin American universities covering the past twenty years. The study was made by consulting Latin American scientific journals and abstracts of mathematical articles published in them and, while spending a year in Colombia, by making a survey of mathematics in the universities and of principal libraries.

Most of the courses in mathematics in Latin American universities are taught in Faculties of Engineering, but in some universities Departments of Mathematics have been established. In these departments courses in mathematics required by the various faculties are taught and programs of study leading to the doctorate in mathematics are offered. Programs for the preparation of teachers of mathematics are also offered. Institutes for mathematical research have been established at a few universities. A summary of mathematics in each of the Latin American countries is given.

A study of mathematical libraries in Colombia has been made and catalogs of mathematical works held by the principal libraries in Bogota have been prepared. The mathematical books in these libraries are chiefly textbooks by Latin American and Spanish authors. There are many Spanish translations of other mathematical works. Works in modern mathematics are gradually being added. There is a small collection of journals in the library of the Department of Mathematics at the National University of Colombia.

Mathematical journals are published in Argentina, Brazil, Cuba and Mexico by mathematical societies in these countries. Mathematical research papers are published also in journals of scientific societies and of faculties of universities, particularly in Uruguay and Peru. These journals also contain mathematical papers from countries outside Latin America. Faculties teaching mathematics have existed for many years, but mathematical societies and journals are of recent origin.

Mathematical research in some centers has been promoted by mathematicians from foreign countries. Native Latin American mathematicians have also contributed to the development of mathematics in the universities, and some have published papers in journals outside Latin America. A list of Latin American mathematical articles published within the past twenty years is given as well as those published in Colombia since 1887.

Microfilm $6.25; Xerox $22.30. 492 pages.

A THEORY OF ADJUSTING PARAMETER-ESTIMATES IN DECISION MODELS

(Order No. Mic 60-5538)

Shiv Kumar Gupta, Ph.D.
Case Institute of Technology, 1960

Exact values of parameters appearing in decision making models are seldom, if ever, known and must be estimated whenever a given decision function is to be used. Traditional statistical techniques of estimation generally fail to take into account consequences of the effect of overestimation and underestimation of the parameters. Consequently, it is desirable to establish procedures for using estimates in such a way that the "cost of error" resulting from their use is reduced. Pragmatically, then, it is important to find a procedure which will minimize the expected cost of error and/or its variance.

The nature of a general solution to this problem is discussed, and a specific method of adjusting parameter estimates is developed. In particular, techniques are given for models involving one parameter, and suggestions are given for extending these techniques to the cases of two or more parameters. In essence, the procedures developed call for adjusting (biasing) estimates in such a way as to take into account the asymmetry of the "cost of error" function, and accomplish the desired reductions.

Calculation procedures are given, and examples are presented which illustrate the usefulness of taking consequences into account when estimates of parameters are used in decision models.

Microfilm $2.75; Xerox $3.00. 58 pages.

METRIZATION AND UNIFORM CONTINUITY

(Order No. Mic 61-1867)

Samuel Charles Hanna, Ph.D.
University of Pittsburgh, 1961

Although the concepts of continuity and uniform continuity are related, they are quite distinct. It is well-known that uniformly continuous functions are continuous, but continuous functions are not necessarily uniformly continuous. It is the object of this dissertation to demonstrate that, given continuous functions from one metric space into another, it is possible to metrize these spaces in such a way that these continuous functions become uniformly continuous.

The results of this paper are presented in three main sections. The first deals specifically with continuous functions from one space to another; the second deals with continuous functions from a space into itself; and finally the third deals with two-directional continuous functions from one space to another.

Microfilm $2.75; Xerox $3.00. 38 pages.

ON S-SPACES AND THE OPEN MAPPING THEOREM

(Order No. Mic 61-1492)

Taqdir Husain, Ph.D.
Syracuse University, 1960

Supervisor: Mark Mahowald

Let e-w* denote the finest topology which coincides with the weak topology $\sigma(E', E)$ on each equicontinuous set of the dual E' of a locally convex (l.c.) linear space E,

and let t_p denote the uniform convergence topology over precompact (totally bounded) sets of E on E'. A l.c. linear space E is called an S-space if, on its dual E', the topologies e-w* and t_p are equal. Examples are given to show that an S-space is a proper generalization of a metrizable l.c. space, and that the class of complete S-spaces is contained in that of B-complete l.c. spaces.

It is shown that the completion of an S-space is also an S-space. A complete S-space, endowed with the Mackey topology, need not be a t-space, unlike Fréchet spaces. A bornological l.c. space need not be an S-space. A subspace H of a complete S-space E such that the closures of Q can be obtained by taking the closures of its precompact sets only, is an S-space. Generally in S-spaces the closure of a set need not be obtained by taking the closures of its precompact sets only (an example to this effect has been given). However, if the closure of a subspace of a complete S-space E is obtained by taking the closures of its precompact sets only, then it is shown that the dual E', endowed with the t_c-topology (uniform convergence topology on convex compact sets of E), is B_r-complete. An example is given showing that the dual of a B-complete space, endowed with the t_c-topology, need not be B-complete.

It is shown that the strict inductive limit E of complete S-spaces E_n's is a complete S-space, provided the dual E', endowed with the t-topology, is bornological. From this it is derived that an $\mathcal{LF}$-space E is a complete S-space (a-fortiori B-complete), provided its dual E', endowed with the t-topology, is bornological. A closed sub-space of a complete S-space is a complete S-space. The countable direct sum E of complete S-spaces E_n's $(n \geq 1)$ is a complete S-space, provided each $E_n'^{tp}$ is bornological. It is also shown that the strong dual of a semi-reflexive l.c. space E_u is a complete S-space (a-fortiori B-complete), provided every u-closed and u-bounded set is u-compact. This theorem leads to the fact that the strong duals of a bornological Montel space and of a metrizable Montel space are complete S-spaces (a-fortiori B-complete), and that a Montel space is a complete S-space, if its strong dual is bornological.

The important theorems like the open mapping –, the closed graph – and the Krein Šmulian theorems, known to be true for Fréchet spaces, are also carried over to complete S-spaces.

Finally, a l.c. space E is said to have the B_c-property if for a given linear space $F \in c$ (a specified class of linear spaces), a linear, continuous and almost open mapping f of E onto F is actually open. It is shown that if c is the class of Fréchet or t-spaces, then E, having the B_c-property, does not imply E is respectively a Fréchet space or a B-complete l.c. space.

Microfilm $2.75; Xerox $3.80. 70 pages.

AN INVOLUTION OF PERIOD SEVENTEEN

(Order No. Mic 61-2237)

John Willis Kenelly, Jr., Ph.D.
The University of Florida, 1961

One of the seventeen families of curves invariant under the homography $x_1' : x_2' : x_3' = x_1 : Ex_2 : E^{15}x_3$, where $E^{17} = 1$, is used in mapping the surface ϕ in S_{10}. The image of the point 0_1 (1, 0, 0) is $0_1'$ (1,0,0,0,0,0,0,0,0,0,0,0). By use of two quadratic transformations on the special curves passing through 0_1 a study of points in the fourteenth and sixth order neighborhoods is made. The projective equivalent of these two neighborhoods is found on the surface ϕ in the first order neighborhood of $0_1'$. The equation of a degenerate cubic cone (quadric cone and a plane), which is tangent to ϕ at this point, is obtained. At $0_{10}'$ (0,0,0,0,0,0,0,0,0,1,0) a similar investigation reveals that the tangent elements are a quintic cone and a quadric cone. However, at $0_{11}'$ (0,0,0,0,0,0,0,0,0,0,1) a degenerate quartic cone (two planes and a quadric cone) is the tangent element.

The surface ϕ is projected in successive steps, beginning at $0_{10}'$, to the surfaces ϕ_i (i = 1, 2, 3, 4, 5, 6, 7). Then certain tangent elements at a selected point on each of the various surfaces are exhibited. These tangent elements are planes for ϕ_i (i = 1, 2, 3, 5, 7), a degenerate quadric cone (two planes) for ϕ_4 and a quadric cone for ϕ_6.

By adding to the transformation T used previously, an additional coordinate X_{12} proportional to the function $g(x_1, x_2, x_3)$, a projectivity T', mapping the points of the plane onto the points of a surface F in S_{11}, is established. Now each point of the plane is mapped onto a point on the surface F. By exhibiting the inverse of T' each point of F is mapped onto a point on the plane. Hence, the surface F is rational.

Microfilm $2.75; Xerox $4.20. 77 pages.

VIBRATION ANALYSIS OF CONTINUOUS BEAM-COLUMNS WITH UNIFORMLY DISTRIBUTED AXIAL LOAD

(Order No. Mic 61-1879)

Earl Harry McKinney, Ph.D.
University of Pittsburgh, 1961

The vibration of a single span beam subjected to constant end and uniformly distributed axial load is considered. The equation of motion is developed through moment analysis. The equilibrium position for such motion is shown to agree with the static deflection of the beam as developed in another paper. The deflections about the equilibrium position then agree with the differential equation obtained by using energy methods. Approximate solutions for the modes of vibration as well as the natural frequencies are obtained through the use of perturbation techniques. General results for the fundamental frequency of a simply supported beam are obtained and compared for both the perturbation method and the energy method with the latter producing the more accurate approximations. Ritz's method is attempted to improve the approximations but is found to be less accurate than Rayleigh's principle unless a large number of terms are used in the series representation of the dynamic deflection curve. The theory, through energy methods, is then extended to approximating the fundamental frequency of vibration of continuous beams of varying section properties and span lengths also subjected to constant end and uniformly distributed axial loading. General results are obtained for beam-columns of n spans pinned at the supports as well as with an

overhanging end under both tensile and compressive gravitational force. Numerical examples are taken to illustrate the results obtained for the fundamental frequency of the simply supported single span beam-column, and the cantilever beam-column, with comparisons made between perturbation and energy methods wherever possible.

Microfilm $2.75; Xerox $3.80. 69 pages.

BEHAVIOR OF CURVES AND SURFACES THROUGH FUNDAMENTAL ELEMENTS OF BIRATIONAL TRANSFORMATIONS

(Order No. Mic 61-1882)

Earle Frederick Myers, Ph.D.
University of Pittsburgh, 1961

It is the purpose of the thesis to examine the behavior of the fundamental points of a birational transformation between two projective three-dimensional spaces S, S′. As is well known, in order to define a birational transformation, a homaloidal (∞^3) system of algebraic surfaces of order $n(\geq 2)$ in one space and a collineation between its elements and the planes of the other space must be given. The fundamental points (common to all surfaces of the homaloidal system) may be isolated points or lie on a curve (which may be a simple or a multiple curve), and from the very definition of the transformation, they have no transformed points in the other space.

However, as a curve or surface through a fundamental point has a definite transformed curve or surface, it is to be expected that some trace of the passage of the original curve or surface through the fundamental point should be found.

The leading idea of the method here adopted is to consider a fundamental point together with a given set of elements (which may be lines, planes, or differential elements of curves or surfaces) and to examine how these elements behave in the transformation.

The transformations examined are the three species of quadratic transformations and two species of cubic transformations. In the homaloidal systems of quadrics considered, the fundamental systems may present simple points, or a point of contact, or simple and double lines, or a conic; the two cubic transformations considered have six distinct lines as their fundamental system.

After the rather elementary investigation of a fundamental point as belonging to a line or to a plane, curvilinear differential elements, E^s, are considered, having their centers either at a simple isolated fundamental point, or at a point of a fundamental line, or at a point of a fundamental conic. The different lines which may be considered as tangents for the E^s include: a generic line, the fundamental line itself, a line which is the join of two fundamental points, a generic line which lies in a plane containing the fundamental points, or a generic line which lies in a face of the (invariant) tetrahedron of reference.

Results may be very different according to the choice of the center and the tangent to an E^s. It may happen that an E^s, passing through a given fundamental point is transformed into an E'^s (as it happens when the center is not a fundamental point). However, there are some surprising and interesting results: an E^s, always with its center at a fundamental point, may be transformed into a set of ∞^1 differential elements, which may be either of an order lower than s, or equal to s, or of an order higher than s.

Microfilm $2.75; Xerox $5.20. 102 pages.

GENERALIZATIONS OF CURVATURES ASSOCIATED WITH A CURVE ON A SURFACE

(Order No. Mic 61-1957)

Joseph Donald Novak, Ph.D.
Michigan State University, 1959

Major Professor: Vernon G. Grove

The main problem of this thesis concerns itself with the generalization of the geodesic curvature, normal curvature and geodesic torsion of a curve on a surface in ordinary space. The method of generalization depends upon introducing at a point of the curve a trihedral which is determined by an arbitrary unit vector V associated with the curve. The generalized curvatures are defined to be the elements of a curvature matrix associated with the trihedral. When the arbitrary vector V is chosen to be the unit vector tangent to the curve, the generalized curvatures simplify to the ordinary geodesic curvature, normal curvature and geodesic torsion of the curve.

The vector V is first limited to be a unit vector in the tangent plane of the surface and the generalized curvatures turn out to be the angular spread of Graustein and the normal curvature and the indicatrix torsion of a vector field studied by Pan. However, the point of view taken in this thesis is different in that the emphasis is placed on the curve with a variable vector V rather than upon a fixed vector field.

The notion, introduced by Grove and Pan, of a first curvature of a curve relative to a congruence of unit vectors associated with the surface is extended by considering the derived vector of any unit vector in the tangent plane as compared to the derived vector of the unit vector tangent to the curve. A relative parallelism is defined which is somewhat different from that obtained by Pan.

When the vector V associated with the curve is allowed to be any unit vector not necessarily tangent to the surface, the generalized curvatures are obtained in terms of the curvatures previously studied for the limited case. A new type of parallelism, called normal parallelism, is defined for vectors which need not lie in the tangent planes of the surface. The asymptotic curves prove to be auto-parallel curves with respect to this normal parallelism.

The theory previously developed is applied to the study of congruences of lines associated with a surface. Conditions are obtained for certain nets of curves on the surface.

A method developed by V. G. Grove for the study of ruled surfaces proves to be important in the above generalizations. Therefore, in the first part of the thesis this method is introduced and extended to characterize ruled surfaces and curves on a ruled surface.

Microfilm $2.75; Xerox $4.60. 87 pages.

ASYMPTOTIC METHODS OF EVALUATING $\int_a^\infty f(x)dx$

(Order No. Mic 60-6993)

Wyman Richardson, Ph.D.
The University of North Carolina, 1960

Supervisor: Harold Hotelling

The central problem studied is to determine approximations to the integral of a known function, f, between the limits a and ∞ that are asymptotically accurate as $a \to \infty$. This approach differs from most previous work in which the limits of integration remain constant and a parameter of $f \to \infty$. Let the definite integral be written F(a). An approximation, $F_1(a)$, is asymptotic if its relative error, $F_1(a)/F(a) - 1$, written $E_1(a)$, $\to 0$ as $a \to \infty$. An asymptotic sequence of approximations, $\{F_n(a)\}$, is one where for all n, $E_{n+1}(a)/E_n(a) \to 0$.

Several iterative procedures that seemed likely to generate asymptotic sequences were studied. Procedures A and B: a monotonic transformation, $y = H(x)$, taking ∞ into 0 and a into b, say, is made and $F[H^{-1}(y)]$ is expanded in a Taylor series about b and 0 respectively. Procedure C: let $v(x) = -f(x)/f'(x)$ and $F_n(x) = u_n(x)\, f(x)$. Starting with an arbitrary u_1, $u_2 = (1 + u_1')v$, $u_3 = (1 + u_2')v$, and so on. Procedure D: starting with an arbitrary $F_1(x)$, $F_2 = -F_1 f/F_1'$, $F_3 = -F_2 f/F_2'$, and so on.

It was found that a useful tool for studying these procedures is Cauchy's concept of order, one definition of which is that if $\log f/\log x \to$ a limit, r, finite or infinite, then the order of f is r. A collection or order theorems with a uniform notation and a consistent method of proof was made. The most important new results are as follows.

1) If $xf'(x)/f(x) \to$ a limit, r, then the order of f is r.

2) If $v'(x) \to$ a limit, t, then the order of $f = -1/t$ and $F \sim |vf/(1-t)|$. This extends a theorem of G. H. Hardy to functions of finite order.

The order concept was extended by breaking up the order classes ∞ and $-\infty$ into subclasses according to the behavior of the logarithms of f.

Applying these tools to the study of Procedures A through D, the following conclusions were reached.

1) Procedure B exists only if H(x) is carefully tailored to fit F(x). The transformation $H(x) = 1/x$, for example, can only work when $f(x) \sim cx^{-n}$.

2) Procedure A exists under more general conditions but is asymptotic only if B exists.

3) Procedures C and D are asymptotic under regularity conditions if the order of f is infinite and either the initial approximation is vf or the extended order of E_1 is less in absolute value than the extended order of f. Procedure C starting with vf is a series discovered by Laplace and Winckler:

$$F(a) \cong f(a)[v(a)+v_2(a)+\ldots+v_n(a)] + \int_a^\infty f(x)v_n'(x)dx,$$

where $v_2(x) = vv'(x)$, $v_3(x) = vv_2'(x)$, and so on.

4) Procedures C and D can be modified when f has finite order by taking linear combinations of succeeding approximations in such a way as to produce asymptoticity.

The following are the most important bound formulas obtained for a convergent integral, F.

1) If $e_1(a) \to 0$ monotonically, then $e_1(a)$ bounds $E_1(a)$ and $E_1(a) \to 0$ monotonically.

2) If $v'(x) \to$ a limit monotonically, then F lies between the asymptotic formulas $\left|\frac{r}{r+1} vf\right|$ and $vf/(1-v')$.

3) If f and $v_n \to 0$ monotonically, then F is bounded by the Laplace-Winckler expansion, first with n-1 terms, then with n terms.

The theory was extended by analogy to integrals with finite tails and to the sum of an infinite series.

In applying these formulas to integrals of interest in statistics, new and useful approximations were obtained for the t, gamma, beta, bivariate normal, and Pearson Type IV distributions.

Microfilm $2.75; Xerox $7.80. 170 pages.

ON THE PRODUCT OF REAL VALUED UNIFORMLY CONTINUOUS FUNCTIONS IN METRIC SPACES

(Order No. Mic 61-1886)

Nicholas John Saber, Ph.D.
University of Pittsburgh, 1961

It is well known that the composite map of two continuous functions is continuous. It is also well known that the product map of two real valued continuous functions is continuous. However, although the composite map of two uniformly continuous functions is uniformly continuous, the product map of two real valued uniformly continuous functions is not necessarily uniformly continuous, as for example, x sin x on the line. This dissertation is concerned with the product of real valued uniformly continuous functions.

The results in this paper are divided into two sections. The first characterizes all those functions which when multiplied by finite products of uniformly continuous functions give uniformly continuous product maps. The second discusses certain conditions which are sufficient to guarantee that the product of two uniformly continuous functions is uniformly continuous.

Microfilm $2.75; Xerox $3.00. 40 pages.

THE EPISTOLA DE PROPORTIONE ET PROPORTIONALITATE OF AMETUS FILIUS IOSEPHI

(Order No. Mic 61-1554)

Sister M. Walter Reginald Schrader O.P., Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Marshall Clagett

In the early part of the tenth century, Ametus Filius Iosephi, an Egyptian Arab, wrote his Epistola de proportione et proportionalitate, a treatise on ratio and proportion. Gerard of Cremona translated the work from the original Arabic into Latin; the Latin version seems to have had considerable popularity in medieval mathematical circles. Since the work exists only in manuscript form, the problem has been to prepare a critical edition from the available manuscript sources.

Microfilm copies of eleven manuscript versions were obtained from eight libraries, seven European and one African. Six versions were used to establish the Latin text; three primary manuscripts were collated throughout and three supplementary manuscripts were used as aids in clarifying obscure readings. The Latin text so established has been translated into English. The mathematical sections of the work are interpreted in modern mathematical symbolism; those sequences where Ametus' reasoning is not obvious have been worked out in detail in footnotes or in the commentary.

The treatise, which was originally written as one undivided text in the form of a letter, has been divided into a prologue, Parts I, II, and III, and a conclusion. The prologue is a dialectical discussion of Euclid's definition of proportion. Part I expands, interprets, and attempts to prove this definition. Part II considers various cases of three, four, and six different quantities in proportion. Part III discusses the forty-eight cases of eighteen possible and six impossible relations arising from six quantities in proportion, each of the twenty-four cases being treated as a proportion first by composition and then by division. These "eighteen combinations" arising from Ptolemy's lemma concerning the divided triangle– a triangle in which two sides are divided interiorly and one side is divided exteriorly by three collinear points– seems to have been the most widely known part of Ametus' treatise.

Ametus was deeply indebted to Euclid; indeed, this work on ratio and proportion is actually an extended commentary on parts of Euclid's fifth book. Ametus also owed much to Ptolemy and through him, to Menelaus; he was also influenced by Archimedes, Apollonius, Plato, and other Greek philosophers and mathematicians. He in turn exerted an influence on Campanus, Leonardo of Pisa, Thomas of Bradwardine, and others of the medieval mathematical world. Ametus received much from his predecessors and he, on his part, handed on to his successors an organized body of authoritative information in the field of ratio and proportion.

Microfilm $4.15; Xerox $14.65. 321 pages.

COMBINATORIAL SCHEDULING: ON FINDING A PARTITION OF A FINITE SET WHICH MAXIMIZES A SET FUNCTION.

(Order No. Mic 61-2506)

Gordon Rae Sherman, Ph.D.
Purdue University, 1961

Major Professor: Stanley Reiter

Scheduling problems facing universities are varied and extremely complex. They are combinatorial in nature and are related to other combinatorial problems which have attracted interest. Some of them are

(1) the scheduling of students to classes

(2) assignment of classrooms to courses

(3) the assignment of instructors to courses and

(4) the construction of a "good" schedule of classes over the hours of a week.

This thesis has attacked the problem of constructing a "good" schedule of classes. In a model formulated in this work, a schedule of classes is a many to one set function, σ, which carries the space of all offered courses into the space of school week hours. The criterion adopted for selecting σ is the minimization of the expected number of conflicts for a randomly drawn student. The problem of selecting the best σ amounts to finding an optimal K set partition of a finite set. This problem is shown to be related to a class of integer linear programming problems. There are two classes of polyhedra associated with these linear programming problems. One is defined by the intersection of finitely many half-spaces. The other is the convex hull of a set of points corresponding to all possible partitions of a finite set. The two classes of polyhedra are related to each other but are not equivalent. Although they appear regular and well behaved, they are difficult to use in the known linear programming algorithms. A stochastic type algorithm is developed which can be used to obtain optimal or near optimal partitions. These type algorithms can be evaluated by means of:

(1) properties of a related random variable

(2) computational speed.

Their application gives rise to a problem in statistical decision theory and their performance is dependent upon some properties of the surface of certain polyhedrons. Since these properties are too complex to study analytically, an experimental approach to their exploration was used. Experimentation with the use of a digital computer revealed several interesting properties of the polyhedrons and indicated that the stochastic algorithm is of practical value in finding an optimal (or near optimal) partition.

Microfilm $2.75; Xerox $8.60. 189 pages.

SOME RESULTS ON THE ANTICENTER OF A GROUP

(Order No. Mic 61-1887)

Georgia Caldwell Smith, Ph.D.
University of Pittsburgh, 1961

The anticenter of a group, as recently defined by N. Levine, is the normal subgroup generated by the elements of the group which satisfy the following condition: $R(G) = \{a \mid ab = ba \text{ implies that } \langle a, b\rangle \text{ is cyclic}\}$. The set, R(G), is called the rim of G, and the symbol, $\langle a, b\rangle$, denotes the group generated by a and b. Then anticenter $G = \langle R(G)\rangle$.

In this study, the defining relations of several infinite systems of groups are used to determine the anticenter. These include the dihedral groups, the dicyclic groups, the generalized dihedral groups, and finite groups that cannot be expressed as direct products of subgroups. Other group properties, having to do with commutativity of elements, are used to determine the anticenter for locally finite

groups, for symmetric and alternating groups, and for certain groups that can be expressed as a direct product of subgroups.

A result established for determination of the anticenter of the specified direct products is the following theorem: If a group G is the direct product of proper normal subgroups A and B, and if all elements of G have finite order, with the orders of the elements of A prime to the orders of the elements of B, then the anticenter of G is the direct product of the anticenters of A and B. More generally: If a group G is the direct product of its p-components, then the anticenter of G is the direct product of the anticenters of the components.

The elements of highest order in the group are found to have particular significance in the determination of the anticenter. It is established that when a finite group has a single cyclic subgroup of highest order and with prime index, then this subgroup is the anticenter and it contains the center properly. Necessarily in this case, the factor group by the anticenter is cyclic.

When the anticenter is proper, it contains the commutator subgroup, and as a consequence, the factor group by the anticenter is abelian.

The anticenter is a characteristic subgroup.

Microfilm $2.75; Xerox $3.00. 46 pages.

STRESS DISTRIBUTION OF A ROTATING LIMAÇON

(Order No. Mic 61-2247)

John Leonard Tilley, Jr., Ph.D.
The University of Florida, 1961

The problem under consideration is that of finding the stress components of a rotating plate of isotropic material in the form of a limaçon rotating about an axis through its centroid perpendicular to the plane of the plate.

The method of attack is that of considering the equivalent problem of a limaçon in a fixed position acted on by appropriate body forces instead of the problem of rotation. This is further simplified by considering the body forces in the x- and y-directions separately and then getting the final solution by superposition of the two results.

The starting point is that of the basic differential equations governing equilibrium of a thin plate subject to body forces in a state of "Generalized Plane Stress." These, taken in conjunction with the compatibility equation for plane stress, yield the partial differential equation, to be solved subject to boundary conditions, of

$$(\nabla^2)^2\phi(x,y) = -(1-\nu)\nabla^2 V(x,y),$$

where $\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}$, ν is Poisson's Ratio, and V(x,y) is the potential function due to the body force.

Letting $\phi(z) = \frac{1}{2}\left[\bar{z}\Psi(z) + z\overline{\Psi(z)} + \chi(z) + \overline{\chi(z)}\right]$ be the complementary function satisfying the homogeneous part of the differential equation and F(x,y) be the particular integral for the differential equation, then a complete solution is

$$\phi = \phi + F .$$

This solution must satisfy the boundary condition

$$-\int V(dx + idy) - (F_x + iF_y) = \Psi(z) + z\overline{\Psi'(z)} + \overline{\chi'(z)}$$

where the V and F are known functions due to the body forces. The dx and dy come from the parametric equations of the limaçon, in this case

$$x = 2\alpha\cos\theta + 2\beta\cos^2\theta - h$$

$$y = 2\alpha\sin\theta + 2\beta\sin\theta\cos\theta$$

where h is the coordinate of the centroid of the limaçon given by

$$r = 2\alpha + 2\beta\cos\theta .$$

By making use of the mapping function

$$z = \beta\zeta^2 + 2\alpha\zeta + \beta - h$$

the figure is transformed into the unit circle in the ζ-plane. Thus the form of $\Psi(\zeta)$ and $\chi'(\zeta)$ are known as they must be analytic in and on the unit circle. Hence

$$\Psi(\zeta) = \sum_{k=1}^{\infty} a_k \zeta^k$$

$$\chi'(\zeta) = \sum_{k=1}^{\infty} b_k \zeta^k$$

Using this representation for these functions, and equating coefficients, the two functions are found, first for the body forces in the y-direction and then for those in the x-direction. The addition of these two results yields the final form of the two functions for the superposed case.

The stress components can then be calculated since they are given by

$$\sigma_x = V + F_{yy} - \frac{1}{2}\left[\bar{z}\Psi''(z) + z\overline{\Psi''(z)} - 2\Psi'(z) - 2\overline{\Psi'(z)} + \chi''(z) + \overline{\chi''(z)}\right]$$

$$\sigma_y = V + F_{xx} + \frac{1}{2}\left[\bar{z}\Psi''(z) + z\overline{\Psi''(z)} + 2\Psi'(z) + 2\overline{\Psi'(z)} + \chi''(z) + \overline{\chi''(z)}\right]$$

$$\tau_{xy} = -F_{xy} - \frac{i}{2}\left[\bar{z}\Psi''(z) - z\overline{\Psi''(z)} + \chi''(z) - \overline{\chi''(z)}\right] .$$

Although the stress components are given here in terms of z, they can easily be converted to the functions involving the ζ by use of the mapping function.

Since a circle is a special case of a limaçon, the results of this paper were checked against the well-known results for a simple rotating disk and were found to coincide exactly with these known stress components for a disk of radius 2α when the limaçon had the form as given above.

Microfilm $2.75; Xerox $4.20. 76 pages.

ON THE MOTIONS OF PARTICLES IN EUCLIDEAN AND NON-EUCLIDEAN SPACES UNDER CERTAIN CONSERVATIVE FORCE FIELDS

(Order No. Mic 60-6753)

Richard Lee Van de Wetering, Ph.D.
Stanford University, 1960

One of the simplest problems in classical mechanics is that of the motions of a particle which moves under the influence of a constant force field in n-dimensional Euclidean space. In vector form, the equations of motion are given by $\ddot{x} = \alpha$, where α is an n-dimensional constant vector.

The force vector α represents a continuous contravariant vector field in the space and as such can be considered as an infinitesimal transformation on the space. In particular, a constant vector represents an infinitesimal translation.

The motions considered in this dissertation are the motions of a particle under the influence of force fields which are generalizations of the infinitesimal translations in Euclidean space. The generalizations are made in two ways. The first generalization depends on some group theoretical properties of the translation group and the second is motivated by some potential theoretic considerations.

The n-dimensional hyperbolic geometry can be represented by the surface $(x,x) = 1$, $x^\circ > 0$, in (n+1)-dimensional Euclidean space with the inner-product being taken according to the Lorentzian metric, i.e., $(x,y) = x^\circ y^\circ - \sum_{i=1}^{n} x^i y^i$. In this geometry the intrinsic acceleration vector is found to be $\ddot{x} + x(\dot{x},\dot{x})$ and the equations of motion have the form $\ddot{x} + x(\dot{x},\dot{x}) = \vec{F}$ with $\vec{F}$ a contravariant vector tangent to the surface $(x,x) = 1$. The motions that are considered in this geometry are those under the action of the force field $\vec{F} = r^{m+2}\nabla_L \varphi_m / r^m$, $(x,x) = r^2$. Here ∇_L is the Lorentz gradient and is obtained from the ordinary gradient by pulling up the indices according to the Lorentzian metric. Also $\varphi_m = (\alpha,x)^m$ where $(\alpha,\alpha) = 0$ and $\alpha^\circ > 0$. C. Loewner (Journal of Rational Mechanics and Analysis, Vol. 5, No. 5, September 1956, pp. 781-804 and Journal of Mathematics and Mechanics, Vol. 8, No. 3, May, 1959, pp. 393-409) has shown that such a force field can be considered as a generalization of an infinitesimal translation. The motions are also discussed when φ_m is replaced by $-\varphi_m$.

An infinitesimal translation in Euclidean space is the gradient of the function $u = \sum_{i=1}^{n} \alpha^i x^i$ which vanishes on a hyperplane and is positive on one side of the hyperplane. The infinitesimal translations in Euclidean space can be generalized to a Riemannian space. In this case, a function u is harmonic if it satisfies the equation $\Delta_2 u = 0$ where Δ_2 is the second Beltrami operator. Given a domain D of the Riemannian space, then if u is a harmonic function, positive in D and vanishing on the boundary of D except at one point where it is unbounded, $\nabla_R u$ can be considered as a generalized infinitesimal translation of D where ∇_R is obtained from the ordinary gradient by pulling up the indices according to the Riemannian metric. The acceleration vector is obtained by taking the intrinsic derivative of the velocity vector and the force field is given by $\nabla_R u$.

As a special case, motions are discussed in the hyperbolic plane. Here the Poincaré model in the upper half-plane is used as a representation of this geometry. In this geometry, functions are harmonic in the usual sense. The particular motions treated are those under the action of the force fields when $u = \pm y$.

The motions in the Euclidean plane are in some respects the most interesting in that the functions from which the force fields are derived are of a more general nature than those already mentioned. In order to describe these functions, let D be a convex domain which contains the point at infinity as a boundary point. Let $f(z) = u(x,y) + iv(x,y)$ be the analytic function that maps D conformally onto the upper half-plane $v > 0$ and takes the point at infinity into the point at infinity. Thus $v(x,y)$ is a positive harmonic function in D and vanishes on the boundary of D except at infinity where it is unbounded. The motions that are discussed are those under the action of the force field $\vec{F} = -\nabla v$. After excluding the case when D is an infinite strip, it is shown that the trajectory intersects the boundary of D and that the particle meets the boundary of D in finite time. The case of the infinite strip is treated separately.

Microfilm $2.75; Xerox $4.40. 83 pages.

A DECISION PROCEDURE FOR THE INCLUSION OF AN INDEPENDENT VARIABLE IN A LINEAR ESTIMATOR

(Order No. Mic 61-2292)

John Thomas Webster, Ph.D.
North Carolina State College, 1960

Supervisor: Richard Loree Anderson

This dissertation considers the usual multiple linear regression model

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p + \varepsilon .$$

The problem considered is which of the following two estimators is the better estimator of E(Y):

$$\hat{Y} = b_0 + b_1 X_1 + b_2 X_2 + \ldots + b_p X_p$$

or

$$\hat{\hat{Y}} = c_0 + c_1 X_1 + c_2 X_2 + \ldots + c_{p-1} X_{p-1} ,$$

where in each case the coefficients are the least squares estimates. It is pointed out that the estimator with the smaller mean square error,

$$E[\hat{Y} - E(Y)]^2 \quad \text{versus} \quad E[\hat{\hat{Y}} - E(Y)]^2,$$

is more practical and often a more desirable estimator than the unbiased, minimum variance estimator.

The mean square error of $\hat{\hat{Y}}$ is shown to be the smaller of the two when

$$\delta = \frac{\beta_p}{\sqrt{\text{Var}\,(b_p)}} < 1 .$$

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

A sample statistic, t, is presented that follows the non-central t-distribution with non-centrality parameter δ. It is then suggested that a rule be followed that

$$\hat{Y} \text{ be the estimator if } |t| \geq t_0$$

$$\text{or } \hat{\hat{Y}} \text{ be the estimator if } |t| < t_0 .$$

The t_0 is that critical point of the non-central t-distribution that minimizes the expected mean square error of the estimator of E(Y) over all probable values of δ. To consider the expected value of the mean square error, an a priori probability density, $f(\delta)$, is introduced.

Two forms of $f(\delta)$ are considered, the rectangular and the normal distribution. Tables of the optimum critical point, t_0, are included for various values of the parameters for these two cases. A graphical presentation of the effect of values of the parameters on the optimum critical point is also included.

Microfilm $2.75; Xerox $4.00. 75 pages.

HIGHER DEGREES OF DISTRIBUTIVITY IN LATTICES OF CONTINUOUS FUNCTIONS

(Order No. Mic 61-2519)

Elliot Carl Weinberg, Ph.D.
Purdue University, 1961

Major Professor: Melvin Henriksen

This work is concerned with lattice distributivity properties expressed by lattice identities with infinitely many variables. Let α and β be cardinals greater than 1. The lattice L is (α,β)-distributive if the following equation and its lattice dual hold identically whenever I is an index set of cardinality α, J is an index set of cardinality β, and the required infima and suprema exist:

$$\inf_{i\in I} \sup_{j\in J} f_{ij} = \sup_{\rho\in J^I} \inf_{i\in I} f_{i\rho(i)} .$$

In recent years, investigations of such distributive laws have been made in the setting of Boolean algebras. Pierce (Pac. J. Math., 7 (1957) pp. 983-992.) extended the class of lattices under consideration by proving, under certain restrictions, that a Boolean algebra A is (α,β)-distributive if and only if the lattice C(S(A)) of all continuous real-valued functions on the space S(A) of dual prime ideals of A is (α,β)-distributive. Our work is motivated by this result.

The set C(X) of all continuous real-valued functions on the topological space X is an archimedean lattice-ordered algebra over the reals with a multiplicative identity which is a weak order unit. Such lattice-ordered algebras will be called Φ-algebras. This is a study of (α,β)-distributivity in Φ-algebras.

In Chapter I, we present the necessary background material and discuss continuous functions which induce lattice homomorphisms with special properties.

The discussion of (α,β)-distributive Φ-algebras begins in Chapter II. In Section 1, a simpler, equivalent formulation of the (α,β)-distributive law for lattice-ordered groups is obtained. We are then able to prove that a Φ-algebra A is (α,β)-distributive precisely when C(M(A)) is (α,β)-distributive. (M(A) is the space of maximal ℓ-ideals of A.) This reduces our field of study to C(X) for compact X.

In Section 2, attention is centered on C(X). An almost-cover of X is defined to be a family of cozerosets of X whose union is dense. (A cozeroset is the complement of a zeroset.) An almost-β-cover is an almost-cover of cardinality β. We then obtain the following topological characterization of (α,β)-distributivity: C(X) is (α,β)-distributive if and only if the members of each α-sequence of almost-β-covers have a common refinement by an almost-cover. The distributivity propositions proved later all depend on this theorem. The result of Pierce mentioned earlier is generalized to arbitrary Boolean algebras, and the theorem that every $(\alpha,2)$-distributive Φ-algebra is (α,α)-distributive is proved.

In Section 3, the boundaries of the subject are more closely examined. Spaces whose Φ-algebras of continuous functions are not (α,β)-distributive for various cardinals α and β are exhibited. For each cardinal α, a connected space X is produced such that C(X) is (α,α)-distributive. It is observed that C(X) is (α,α)-distributive for every cardinal α precisely when X has a dense set of isolated points. Finally, another theorem of Pierce is generalized. (Let w_o denote the first infinite cardinal.) If C(X) is (w_o,w_o)-distributive, then each function in C(X) has a dense set on which it is locally constant.

In Chapter III, attention is focused on the problem of embedding a Φ-algebra as a "nice" sub-Φ-algebra of an α-complete Φ-algebra. Most of the results obtained are for bounded Φ-algebras. In Section 1, we prove that every bounded, (α,α)-distributive Φ-algebra A can be embedded as a regular sub-Φ-algebra of a bounded, (α,α)-distributive, α-complete Φ-algebra A_α. The object of Section 2 is to identify A_α more precisely. In the special case where A is isomorphic to C(X) for some compact space X, we show that each α-complete Φ-algebra in which A is embedded as a regular sub-Φ-algebra contains a regular sub-Φ-algebra isomorphic to A_α.

Section 3 contains isolated results concerning the completion of Φ-algebras and Boolean algebras.

Microfilm $2.75; Xerox $3.80. 69 pages.

AUGMENTATION TECHNIQUES IN THE THEORY OF QUEUES

(Order No. Mic 61-2007)

David Matthew G. Wishart, Ph.D.
Princeton University, 1960

The first part of this thesis is devoted to a discussion of queuing systems denoted in Kendall's notation (Ann. Math. Stat. 24 (1953) 338-354) by $GI/E_k/s$. N(t) — the number of customers in the system at time t — is not a Markov process. An integer-valued function n(t) (describing the state of the service mechanism) is adjoined and the vector-valued function [N(t),n(t)] considered at epochs of arrival. This process is shown to be a homogeneous Markov chain. The matrix of one-step transition probabilities is set up in two cases: (i) s = 1, general k; (ii) s = k = 2. These systems are shown to be ergodic when $b/sa < 1$, { b ≡ mean service-time: a ≡ mean

inter-arrival interval = $\int_0^\infty u\, dA(u)\}$, and stationary distributions are obtained.

The second part of the thesis presents a new description of the system M/G/1. Again, N(t) is not a Markov process, but if we adjoin y(t) — the unexpended service-time of the customer at the service point — the vector-valued process [N(t),y(t)] possesses the Markov property for all t. Difference-differential equations are set up and solved along the lines indicated by Cox (Proc. Camb. Phil. Soc. 51 (1955) 433-441).

If the process is considered at arrival epochs we have a homogeneous Markov chain $\{[N_k,y_k],\ k = 0,1,2,\dots\}$ taking its values in a locally compact Hausdorff space. The Markov property defines an operator T on the class of regular Borel measures. It is shown that T is not quasi-weakly compact, so that the ergodic theorems of Yosida and Kakutani (Ann. Math. (2) 42 (1941) 188-288) do not apply.

The equation $T\Phi = \lambda\Phi$ is discussed. It is shown that:

1) $\lambda = 1$ is a unique characteristic value of T;

2) when $b \geq a$ there is no solution of $T\Phi = \Phi$;

3) when $b < a$ there is a unique probability distribution $\overline{\Phi}$ satisfying $T\overline{\Phi} = \overline{\Phi}$.

The operator T determines the transition probability function $P(\cdot,\cdot)$, and hence also, by induction, the sequence of functions $P_r(\cdot,\cdot)$ — the r-step transition probabilities. It is proved that $P(x,\cdot)$ is absolutely continuous with respect to $\overline{\Phi}(\cdot)$. It follows from the Individual Ergodic Theorem for Markov Chains (Doob, Trans. Amer. Math. Soc. 44 (1938) 87-150; Kakutani, Proc. Imp. Acad. Tokyo 16 (1940) 49-54) that the sequence $\{P_r(x,F)\}$ converges in the (C,1) sense to (F) for all x and F.

In the last section we compare the waiting-time distributions for customers in this system under the queue disciplines 'first come, first served' and 'last come, first served.' It is shown that the mean waiting-times are identical but the variance of the waiting-time distribution is always smaller with 'first come, first served.'

Microfilm $2.75; Xerox $5.20. 105 pages.

MINERALOGY

PHASE-EQUILIBRIUM STUDIES ON TEKTITE AND METEORITE SYSTEMS

(Order No. Mic 61-2362)

William Arthur Cassidy, Ph.D.
The Pennsylvania State University, 1961

Various origins for meteorites have been suggested in the literature. There has also been a controversy in the literature over whether or not tektites are meteorites. The present work describes a phase-equilibrium study on tektite and meteorite systems, using the method of quenching. Part I tests the hypothesis that a liquid of tektite composition could have been produced by fractionation due to liquid immiscibility in a magma of requisite composition. Even though runs made on some mixtures appeared to produce nonhomogeneous glasses, liquid immiscibility was not found and negative results are reported. Part II, a phase-equilibrium study of the system Fe-FeO-MgO-SiO_2, represents the beginning of a more rigorous approach to tektite investigations, but is also useful as the basis for a discussion of the compositions of chondrites, and in addition is interesting because it is the first inorganic system in which the occurrence of three mutually immiscible liquids is described. A large region in the ternary system Fe-FeO-SiO_2 contains compositions that split into three immiscible liquids above $1681 \pm 2°C$; in the rest of the system mixtures form two immiscible liquids at high temperature. The compositions of the three liquids in equilibrium at $1681 \pm 2°C$ are as follows: (1) almost pure Fe, (2) almost pure SiO_2, and (3) a liquid containing 58 per cent SiO_2 and 42 per cent FeO. In most of the rest of the system liquid iron coexists at temperatures greater than 1524° to 1528°C with a liquid containing iron oxide plus SiO_2. These three-liquid and two-liquid regions extend into the quaternary system Fe-FeO-MgO-SiO_2, describing compositional volumes that occupy the tetrahedron almost completely. The compositions of chondrites fall in this tetrahedron in the region where two liquids coexist at temperatures greater than about 1528°C, and the oxide liquid contains varying proportions of FeO, MgO, and SiO_2, with small equilibrium amounts of Fe_2O_3.

The temperature of first formation of two liquids along the FeO-SiO_2 join is revised from $1698 \pm 10°C$ to $1681 \pm 2°C$, both on the 1948 International Scale. It is also shown experimentally that the liquid-immiscibility dome along the FeO-SiO_2 join closes over at about 1800°C, but for mixtures in the three-liquid region immiscibility persists to at least 1850°C, and probably persists up to the vaporus surface. This would be of interest to those considering cosmological processes such as cooling of primordial material from a vapor through a liquid stage to a solid, because it suggests a method of extreme fractionation under these conditions.

A plot is given of the analyses of 100 chondrites on the plane containing 25 per cent MgO in the system Fe-FeO-MgO-SiO_2, as an example of possible applications of the present work. This plot illustrates the uniformity in composition shown by chondrites, but provides no compositional basis for further dividing the subclass of chondrites.

Microfilm $2.75; Xerox $6.60. 139 pages.

CAUSES OF OPTICAL SCATTER IN PLAGIOCLASE FELDSPAR

(Order No. Mic 61-1527)

Robert Charles Doman, Ph.D.
The University of Wisconsin, 1961

Supervisor: Associate Professor Sturges W. Bailey

An optical and x-ray study of the low temperature plagioclase feldspars was initiated for the purpose of explaining the large variation of refractive indices within many chemically analyzed samples. It was believed at the start that the linear change with composition of the relative positions of the subsidiary reflections on c axis x-ray oscillation photographs, termed $\mathcal{G}_c$, could be employed to obtain the chemical composition of individual plagioclase grains. The $\mathcal{G}_c$ values showed considerable scatter, however, and were considered ineffective for obtaining accurate compositions. The $\mathcal{G}_c$ values appear to have a statistical, but not exact, dependence on composition.

Since the chemical composition of individual grains could not be obtained from the subsidiary reflections, a combined x-ray and optical technique was developed for determining anorthite contents of individual grains of low temperature plagioclase feldspars. It was discovered that γ^* values are mutually related to refractive indices and mol percent anorthite. Thus, accurate mol percent anorthite content can be obtained by measuring the refractive index α and the reciprocal angle γ^* on the same grain. The refractive indices are measured directly on the five-axis universal stage using the double variation method with high dispersion liquids. The grain is mounted on a spindle attachment so it can be recovered for determination of γ^* from an x-ray precession photograph. It was shown by using these techniques that the relatively large optical scatter found on existing refractive index curves results primarily from variations of chemical composition of individual grains within a sample, amounting to as much as 8.5 percent An in certain samples of G. S. A. Memoir 52 (Emmons, 1953).

Five optical breaks and structural discontinuities of γ^* have been established at $An_{5\pm2}$, $An_{15\pm2}$, $An_{35\pm2}$, $An_{52\pm2}$, and An_{90-95}. It is interesting to compare these breaks with data published by others. Each of these discontinuities appear on one or several of the published curves where the following parameter is plotted against composition: $[2\theta(1\bar{3}1) - 2\theta(131)]$, birefringence $(\beta - \alpha)$, refractive indices, 2V values, and the variation of microhardness with compression. In many of these curves the discontinuities have not been recognized as such due to the lack of precise compositional control.

The accuracy of the reported bulk analyses of samples 14 and 15 of G. S. A. Memoir 52 is questioned. Refractive indices, γ^*, $\mathcal{G}_c$, and $[2\theta(1\bar{3}1) - 2\theta(131)]$ values all suggest that sample 14 has a composition of approximately 56 percent rather than the reported 58.3 percent anorthite and that sample 15 has a composition of approximately 68 percent rather than the reported 58.6 percent anorthite.

New refractive index curves were constructed plotting indices against mol percent anorthite determined from the described optical and x-ray method. It is believed that the An content can be determined by the α refractive index with reasonable accuracy with the use of J. R. Smith's curve (1960) or the curve published in Memoir 52. The major difference of the present curves with these previously published curves appear in the region between An_{30} and An_{35}. The birefringence curves of J. R. Smith appear to be quite reliable. All of the optical properties can be determined from the latter curves if only one index is accurately known.

The results of preliminary studies of the relationship of γ^* to high temperature and transitional natural plagioclases suggest a need for a study of the effect of γ^* of natural plagioclases with these thermal histories. The new curves presented in this study are tentative in the regions of An_{35} to An_{45} and An_{85} to An_{95} and are subject to change when more data become available. There seems to be a lack of natural plagioclases within these compositional ranges.

Microfilm $2.75; Xerox $4.80. 95 pages.

A STUDY OF THE INCORPORATION OF URANIUM BY SYNTHESIZED CRYSTALS OF LEAD SULFIDE

(Order No. Mic 61-2375)

Joseph John Hutta, Ph.D.
The Pennsylvania State University, 1961

The observation that base metal sulfides associated with hydrothermal uraninite deposits contain uranium has suggested their use as a guide in uranium exploration. This study was undertaken to answer questions pertinent to their usefulness in this application. Of importance were questions concerning whether uranium could be both incorporated during formation of the sulfide crystals and introduced subsequently to their formation and whether the two could be differentiated. It was also considered important to determine the manner in which uranium is contained in the sulfides and the factors which control the amount of uranium incorporated.

In an attempt to answer these questions, galena was synthesized hydrothermally in the presence of uranium over a range of temperatures at constant pressure and the products were subjected to radiometric measurement of the uranium concentration and autoradiographic observation of distribution of the uranium.

It has been found that uranium is incorporated by galena during hydrothermal crystal growth, the amount entering being dependent on the temperature of crystallization. It may also be introduced into previously crystallized galena within the time limits of experimentation, but only along cleavages. This feature may serve to differentiate such noncontemporaneously introduced uranium from that incorporated during crystallization. Open cleavages were not observed in crystals grown in this investigation.

The amount of uranium incorporated ranged from 900 p.p.m. at 215°C. to less than 100 p.p.m. at 600°C. Low temperature specimens are characterized by clusters of tens to hundreds of alpha tracks, and the high temperature specimens by a few single tracks per crystal. The upper size limit for uranium particles capable of producing single tracks is calculated to be less than 2.0 μ^3. The inverse temperature relationship indicates that the uranium is not present as atoms or ions in crystalline solid solution. The sizes of the particles required to produce clusters of

tracks suggest that the uranium is incorporated by adsorption rather than by crystalline solid solution. Decreasing availability of uranium due to the decreasing solubility of uranium with increasing temperature, a decrease in the number and size of lattice imperfections with increasing temperature, the possibility of the formation of colloidal sols of decreasing particle size with increasing temperature, or some combination of these could account for the inverse relationship observed between uranium content and temperature.

A parallel investigation of the solid solubility of Ag_2S in galena using the hydrothermal method for growing the galena crystals and the radioisotope Ag-110 as a tracer showed a systematic increase in Ag_2S content from 0.02 mol percent at 300°C. to 0.53 mol percent at 600°C. This result demonstrates that the crystal growing technique is applicable to a system in which solid solution occurs.

Microfilm $2.75; Xerox $5.80. 116 pages.

PHASE EQUILIBRIUM AND CRYSTAL CHEMICAL RELATIONSHIPS IN RARE EARTH SYSTEMS

(Order No. Mic 61-2406)

Israel Warshaw, Ph.D.
The Pennsylvania State University, 1961

A study of the crystal chemistry, compound formation and phase equilibrium relationships in rare earth oxide, aluminate and silicate systems was undertaken to determine the effect of slight changes in ionic radius on compound formation and liquid immiscibility and to determine the possible sub-groups of the lanthanon elements.

Contrary to what has been published previously, the polymorphic transformations of all the rare earth oxides are reversible under equilibrium conditions. Furthermore, none of the rare earth sesquioxides exists in more than two polymorphic forms.

A new rare earth aluminate compound, $2Ln_2O_3 \cdot Al_2O_3$, forms with many of the smaller rare earth ions. This together with the fact that the metastable 1:1 distorted perovskite compound tends to form readily in these systems has made it possible to clarify many conflicting results which have been reported previously. The 3:5 garnet-type compound is stable and melts congruently without undergoing any inversion.

Compounds form at only two compositions, 1:1 and 1:2, in all rare earth silicate systems. The structural relationships are quite complex and there are three or four different structures for each composition. The changes in the extent of the liquid-miscibility gap in the rare earth oxide-silica systems are quite striking. While the extent of the liquid-miscibility gap increases with decreasing radius of the modifier cation, the liquidus temperature of the two-liquid region increases sharply in those systems involving the last three oxides, and the primary phase below the two-liquid dome is no longer cristobalite but a rare earth silicate. This study has shown not only that such occurrences are more common in silicate systems than previously anticipated but also that the extent of the liquid-miscibility gap can be related, at least empirically, to the ionic potential of the modifier cation.

The rare earths should be divided into three separate groups, comprising the large, intermediate and small rare earths. In general, the groups consist of the elements lanthanum to neodymium, samarium to dysprosium, and holmium to lutetium.

Microfilm $2.75; Xerox $5.60. 114 pages.

MUSIC

INTERDEPENDENCE OF WORD AND TONE IN THE DRAMATIC MUSIC OF HENRY PURCELL

(Order No. Mic 61-1216)

Joan Colleen Patton Bicknell, Ph.D.
Stanford University, 1961

The relationship between word and tone is not a fixed one. Through epochs and civilizations the balance of their problematic union has been fluctuating; each search for momentary equilibrium has given rise to new theoretical and technical solutions. It would be erroneous to assume that an ideal union has been or could be attained; as Francois Lesure succinctly states, "That union is merely a function of the individual sensitivities of creators and listeners, and of the status of the two arts [the verbal and the musical]."[1] Consequently, Part I (The Nature of the Problem) of this dissertation is devoted to a thorough probing of "the individual sensitivities of creators and listeners" before and during the time of Henry Purcell.

From their references to the interdependence of word and tone it is possible to isolate, define, and categorize the levels at which this union may operate.

I) Patterns of feeling

A) Affective quality

B) Dramatic or rhetorical rhythm, i.e., the affective nuance within the over-all mood

C) Mimetic rhythm

D) Figurative word painting, i.e., ornamental treatment of words or phrases with striking emotive connotations.

II) Patterns of meaning

A) Metrical and accentual rhythm

B) Declamatory rhythm and inflectional contour

C) Disposition of the original text

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

D) Onomatopoeia and literal word painting, i.e., ornamental emphasis of words or phrases with logically significant denotations or those describing dramatic action.

The procedures brought into play by the first group involve dramatic or rhetorical unity, the movement of emotional intensity, and the correspondence of connotations, while those of the second involve cognitive or logical unity, the movement of intellectual subtlety, and the correspondence of denotations.

Part II (The Nature of the Text) and the opening chapter of Part III (The Nature of the Music) are concerned with the second of Lesure's conditions, the status of the two arts. It is shown that Restoration drama revolved around stock situations and scenic display and was couched in the language of the high style, in the case of heroic tragedy, and the plain style, in the case of genteel comedy. Common genres of verse in these and other less typical Restoration theatricals include the love lyric, the pastoral romance, the cavalier lyric, and the ceremonial song. The status of the musical art is shown to have been the issue of experiments by such composers as Merbecke, Tomkins, Dowland, Locke, Humfrey, and Blow; each of these mark distinctive phases in the evolution of a satisfactory solution to the union of word and tone, and each established tendencies which Purcell subsequently molded into a dramatic style perfectly suited to the theatrical and musical needs of his day.

The remaining chapters of the third part describe and define Purcell's individual approach to this complex combination, adopting the levels outlined above as factors to be considered in a systematic analysis. It is demonstrated that affections are established and maintained through the interaction of certain typical musical resources (e.g., the minor mode and minuet rhythms to express sorrow; the major mode and canarie rhythms to express joy) and through adherence to a tonal, rhythmic, or stylistic norm. On a lower level, these same correspondences serve to delineate the subtlest of rhetorical nuances. As in pure drama of the Restoration, Purcell's characters are one-dimensional, painted with the brush used in the expression of the affections; however, their daring juxtaposition creates a vitally realistic image.

Similarly, Purcell's precise expression of metrical and accentual rhythm and inflectional contour approximates conversational speech as closely as do the wit duels of genteel comedy. His ingenious clarification of declamatory rhythm is akin in effect to the heroic rhetoric of expectation. Each conceptual unit, each rhetorical figure, is distinctly articulated. Both figurative and literal word painting, achieve, like the prose of genteel comedy, a quality of authenticity through a wealth of realistic detail. In short, the conventions of poetry and music are matched and balanced with a genius yet to be surpassed in English opera.

1. Lesure, Musicians and poets of the French Renaissance (New York, Merlin Press, 1955).

Microfilm $3.55; Xerox $12.40. 273 pages.

HENRY KIMBALL HADLEY: HIS LIFE AND WORKS (1871-1937).

(Order No. Mic 60-3306)

John Clair Canfield, Jr., Ed.D.
The Florida State University, 1960

This dissertation is a study of the life of Henry Kimball Hadley, American composer, conductor, and proponent of American music, who lived from 1871 to 1937. Personal influences on Hadley's life are recorded, as well as his influence on others. From this antithetical procedure, an attempt is made to ascertain his relative importance in the field of American music. An appendix includes a complete listing of his known compositions, both published and in manuscript form.

Hadley was born, raised, and received his early training as a musician in New England. From early childhood, he manifested an unusual talent for music, particularly in the area of composition.

Through the purposeful guidance of Hadley's father and association with pedagogues and musicians such as George Chadwick, Victor Herbert, and others, Hadley received thorough instruction in composition, violin, piano, and conducting. In addition, he was given numerous opportunities to utilize his plenary training through practical experiences engendered by his father and others.

Hadley lived during an era when the music profession was not attractive to ambitious young Americans since native musicians found little performance opportunity but experienced hardship and discouragement. That Hadley was able to achieve distinction as a musician, both in the United States and abroad, attested to his ability, his thorough preparation and his insatiable drive.

Hadley was also one of America's foremost personages. He gained this recognition during his lifetime because of his activities not only as composer and conductor, but as promoter, innovator, organizer, socialite and philanthropist. Through his abilities as a creative artist and aggressive organizer, he was able to realize many pioneer achievements in the music profession. He received many awards and honors and attained the distinction of being:

1. The first American composer to be successful in all forms of serious music.
2. Composer of the first musical score recorded for a motion picture.
3. Conductor and narrator for one of the first music education programs broadcast over radio in the United States.
4. The first American to be engaged as conductor of a major symphony orchestra in the United States, as well as the first American to conduct opera performances at the Metropolitan Opera House.
5. The first American to establish a prominent reputation in Europe and other continents as composer-conductor.
6. One of the foremost proponents of American music and musicians.
7. Founder of the Berkshire Music Festival and the National Association of American Composers and Conductors.
8. The recipient of numerous composition awards, government honors, and honorary doctor's degrees.

In view of: (1) Hadley's pioneer achievements in the profession of music, as well as honors and awards bestowed

on him, (2) his prolific activity and artistic attainments in the area of music composition, (3) his exceptional activity and pre-eminent position as director of symphonic and choral organizations, (4) his deep concern and active crusade for domestic recognition of American composers, it seems obvious that in the annals of music history of the United States, Hadley's name should forever be enshrined as one of America's greatest musicians.

Microfilm $4.95; Xerox $17.35. 385 pages.

TONALITY

(Order No. Mic 60-6953)

Molly Malcolmson Gustin, Ph.D.
Indiana University, 1961

This dissertation is an attempt to show that the syntax of tonal music, as defined herein, is richer than that of atonal music, in that it presents more possibilities of unity, variety, complexity, order, consistency, and continuity than does the syntax of atonal music. Since the semantics of music is the direct result of the syntax, the form and the content of music being inseparable, it follows that the expressive possibilities of tonal music are greater than those of atonal music.

A mathematical, operational definition of root is given. A procedure is described which determines, of any set of tones, whether it has a single predominant root, no root, or many roots. It is then demonstrated that the sets of tones which constitute the diatonic major and harmonic minor scales have a single predominant root, and that the sets of tones which constitute the twelve-tone and the nineteen-tone scales do not.

A metrical theory is presented which is an extension of the theory of pitch, according to which meter is an integral part of tonality.

The paradox of functional analysis of music, namely: "The altered tone is in the key, and the altered tone is not in the key" is resolved by distinguishing between lower and higher order keys. As a result, a meaningful and consistent method of functional analysis of music which does not depend upon the analyser's intuition, and which yields new insights into the structure of music of all periods and styles, is developed. In the course of this development a number of important words, whose meaning has become clouded or even contradictory, are defined, in some cases quantitatively. These definitions amplify, rather than violate, the definitions in Webster's Dictionary.

A distinction is drawn between tonal and atonal music, and a measure of the degree of tonality of tonal music is defined. According to this definition, all Western music composed before the twentieth century is tonal, in greater or lesser degree.

Arguments are presented to substantiate the hypotheses that tonal music can be more unified than atonal music because of the presence of one or more common measures among its tones; more various than tonal music because the functional combinations and permutations available to the single tone are greater; more complexly ordered than atonal music because the quantity of levels of hierarchical order can be greater; more consistent than atonal music because tonal music is a formalism the whole of which is patterned after the nature of its elements, and in which, therefore, the ordering of the macrocosm reflects the ordering of the microcosm; more expressive than atonal music because tonal music can draw upon the expressive variety of its greater quantity of functional complexes, and thus does not need to resort to the violation of cultural norms as a source of expression. Tonal music can have greater continuity than can atonal music, because the continuity in tonal music is maintained at the deepest level by the presence of one or more common measures between the pitches, rather than by the relatively superficial methods of continuous flow, cyclic form, or serial order.

Microfilm $2.75; Xerox $8.00. 171 pages.

SYMPHONY NO. 1.

(Order No. Mic 61-1289)

Roger A. McDuffie, Jr., D.Mus.
The Florida State University, 1961

This symphony comprises three interconnected movements which are thematically interrelated through the presence of first movement ideas in the second and third movements.

The first movement, moderate, is in modified sonata form and progresses through several tempo changes: moderate, fast, slow, and moderate. The second movement, slow, unfolds in a large three-part form. The last movement, fast, is in a modified sonata form. The symphony lasts about nineteen minutes.

Both melody and harmony are dominated by the tritone. The fast music features strong, unevenly spaced accents. Brass and percussion are used prominently in an orchestra composed of one piccolo, two flutes, two oboes, two clarinets in B-flat, two bassoons, four French horns in F, three trumpets in B-flat, two tenor trombones, one bass trombone, one tuba, four timpani, snare drum, bass drum, cymbals, triangle, xylophone, and strings.

Microfilm $2.75; Xerox $5.00. 99 pages.

A TRANSLATION AND CRITIQUE OF LA MUSIQUE ET LA VIE INTÉRIEURE BY LUCIEN BOURGUÈS AND ALEXANDRE DENÉRÉAZ (A PSYCHO-MUSICO-AESTHETIC STUDY) PARTS I-III

(Order No. Mic 61-1931)

Gloria Bader Merchant, Ph.D.
State University of Iowa, 1961

Chairman: Professor Albert T. Luper

Lucien Bourguès, a French psychologist, and Alexandre Denéréaz, a Swiss musician, published a book entitled La Musique et la vie intérieure in 1921. It points to a relationship between the inner life of an epoch and the music produced during the same period. Music is thus viewed as a psychological phenomenon proceeding from the deepest

springs of consciousness. As Denéréaz himself points out, his work "is a history of psychological phenomena of a musical order, a study of successive metamorphoses of sound working over the centuries through human spirits."

The first seventy-three pages are devoted to establishing the scientific foundation which underlies the historical and aesthetic treatment of the subject. Various epochs in musical history are discussed in seven books. The first deals with the Orient, Greece, and Rome; the second elaborates the contribution of the Middle Ages, with special emphasis on the gradual unfolding of the harmonic and tonal senses, the interrelation of harmony and counterpoint, and the nature of tonality; the third discusses the rise of "individualistic" music during the Renaissance, the organization of certain dissonances into chord formations, the significance of the cadence, and the nature of musical style; the fourth emphasizes four eighteenth-century composers -- Rameau, Handel, Bach, and Gluck; the fifth studies three great classicists, namely, Haydn, Mozart, and Beethoven; the sixth analyzes the works of such romantic composers as Weber, Schubert, Berlioz, Mendelssohn, Chopin, and Schumann; the seventh evaluates such "modern" musicians as Liszt, Wagner, Franck, Brahms, Tchaikovsky, Grieg, Moussorgsky, Richard Strauss, and Debussy. Several additional essays are concerned with the spirit of modern music and specific contemporary techniques, such as pandiatonicism, pentatonic writing influenced by the Javanese gamelan, and polytonality.

Musical examples abound in the text. At the conclusion of most large sections dealing with specific periods and in some shorter essays on individual composers, the instruments employed at the time and/or the type of orchestra utilized by the composer are summarized. These listings appear in a table headed "Evolution of Sonorous Material." Nineteen filiation charts are included in the syntax that indicate relationships of composers in chronological order.

The writer of this dissertation has included an introductory study dealing with various aspects of the translated work. There are five sections in the commentary, which is primarily concerned with a consideration of the place this book occupies in the evolution of French musical culture. The subjects treated include (1) historical perspectives, (2) the book and its background, (3) the physio-psychological aspect, (4) historical aspects of aesthetic theory, and (5) aspects of style in La Musique et la vie intérieure.

The fundamental contribution made by Bourguès and Denéréaz is briefly summed up by Dr. Warren D. Allen in his Philosophies of Music History when he describes the work as "the most extensive attempt to write a psychological history of music." The French authors seek to integrate history, theory, and aesthetics, revealing thereby a breadth of conception not too frequently found. The title of the work gives a clue to its general underlying assumption, namely, that there is a relationship between the inner life of an epoch and the music produced during this time span.

Microfilm $14.20; Xerox $51.05. 1134 pages.

SYMPHONY NO. 2, OPUS NO. 25.

(Order No. Mic 61-1291)

Frederick Mueller, D.Mus.
The Florida State University, 1961

The symphony number 2, opus 25 consists of a musical composition in the form of a sonata for large symphonic orchestra.

This work is highly unified formally, and is divided into four separate but interrelated movements. The individual movements are titled: I. Andante Lacrimosa, Allegro; II. Scherzo; III. Siciliano: IV Chaconne.

The first movement is the longest, and it begins with a slow introduction followed by Allegro. The movement closes quietly and literally dies out. The second movement follows in form of a virtuose scherzo. The mood of the third movement represents calm, quiet, and serenity. Its title is Siciliano. The finale, titled Chaconne, brings the symphony to a climactic and wilfully conceived ending.

The orchestration for the first and last movements is massive and bold, while the two middle movements are reduced in texture for sake of contrast. Unification is achieved by repeating the opening tonality of D in the second movement, in parts of the third movement, and again in the coda of the last movement. The structure of the over-all relationships between movements (I: A, II: D, III: E-flat or E, IV: D) spells out thematic material found in all movements.

Melodic materials initiated in the introduction of the symphony are repeated in all parts of the work. Their reappearance in other movements is marked by ammendation or variation of rhythm and texture.

As in formal examples of structure, such as Beethoven Symphonies and String Quartets, this symphony has used the following formal devices:

1. Identical subjects or melodic fragments serve different functions of formal structure.
2. Themes, while introduced early, do not flower nor mature until the climax of the finale has been reached.
3. Extensive imitation has been reserved for development sections only, or saved for use in the final movement.

Classic third movements which were reduced in scope because of their menuet character are analogous to the quiet chamber music texture of the Siciliano. No analogy between Beethoven symphonies and this symphony may be made.

The composer has only attempted to guide himself according to precepts and art forms of the progenitor of the greatest symphonies ever written.

The mood and musical expressions of this symphony are those of introspection and gravity.

Microfilm $2.75; Xerox $5.60. 115 pages.

THE EFFECTS OF NEUROHYPOPHYSIAL HORMONES ON ELECTROLYTE EXCRETION AND RENAL HEMODYNAMICS IN DOGS

(Order No. Mic 61-1398)

Wah-Yip Chan, Ph.D.
Columbia University, 1961

Natriuretic responses to arginine vasopressin and oxytocin have been demonstrated in conscious dogs in confirmation of earlier works. Studies on two closely related synthetic analogues, arginine vasotocin and oxypressin, indicate that arginine is important to the activity of arginine vasopressin on electrolyte excretion. The substitution of isoleucine for phenylalanine in arginine vasopressin increases the natriuretic activity relative to antidiuretic activity. Arginine vasotocin is stronger than arginine vasopressin which, in turn, is stronger than oxypressin in relative natriuretic activity.

An attempt was made to localize the site at which oxytocin acts to increase electrolyte excretion. Injections into the carotid and renal arteries and into the cerebral ventricles indicate that oxytocin may act on a central receptor. The reported existence of central antagonism between vasopressin and oxytocin is not supported by our data.

We also demonstrated a pharmacological dissociation of antidiuretic and saluretic responses to vasopressin. Antidiuresis persists throughout prolonged infusion of vasopressin while saluresis subsides after the first hour.

Evidence is presented that the saluretic response to oxytocin requires the simultaneous presence of vasopressin.

We failed to confirm the reported renal hemodynamic response to oxytocin in clearance experiments.

The possible physiological significance of neurohypophysial hormones in the regulation of body electrolytes is discussed. Microfilm $2.75; Xerox $5.80. 119 pages.

EFFECTS OF MESCALINE ON SEVERAL BEHAVIOR PATTERNS IN THE RAT, A PSYCHOPHARMACOLOGICAL STUDY.

(Order No. Mic 60-3781)

Stephan Lewis Chorover, Ph.D.
New York University, 1960

Research Adviser: Dr. Hans-Lukas Teuber

Mescaline (3,4,5-trimethoxy-phenyl-ethyl-amine) is one of nine alkaloids contained in peyote, an ancient drug obtained from the Mexican dumpling cactus (Lophophora williamsii). Interest in mescaline derives from the fact that it produces hallucinations, delusions and similar "psychotic-like" behavioral effects in otherwise normal persons. Such sensory and perceptual actions, as well as changes in function of the autonomic nervous system, have been widely studied in man. Much less is known about the effects of mescaline on behavior of experimental animals. In the present investigation, a series of experiments was performed on rats to determine the behavioral actions of mescaline sulfate and to compare the effects of this drug with those produced by a contrasting agent: chlorpromazine hydrochloride. The results of this study are summarized below under four separate headings.

1. Effects of mescaline on extinction of conditional avoidance response (CAR).

Male albino rats were trained to perform the CAR in a modified shuttle-box. The animals were required to move from one compartment to the other at the onset of an auditory conditional stimulus (buzzer, CS). At the conclusion of training (to a criterion of 90% correct) extinction trials were begun. On these trials, the unconditional stimulus (US, 1.5 ma shock to the feet) was omitted.

(a) The CAR was immediately and uniformly suppressed following intraperitoneal (ip) administration of 25 mg/kg mescaline.

(b) Suppression of the CAR persisted throughout 11 days of testing in the absence of further drug administration (i.e. the CAR was extinguished).

(c) Low latency escape responses remained intact after CAR disappearance.

(d) Spontaneous locomotor activity (as measured in a modified Thompson maze) was unaffected by the drug.

2. Effects of mescaline on locomotor activity.

Spontaneous locomotor activity was measured by permitting rats to run freely in an activity wheel. Forced running was produced by rotating the 15" wheel at 3.3, 6.6 and 10.0 rpm.

(a) Spontaneous activity was depressed following administration of 25 and 50 mg/kg mescaline ip. Chlorpromazine (5 mg/kg ip) exerted a similar, but more pronounced, effect.

(b) Under the forced running condition, the effects of mescaline and chlorpromazine were dissociable. Chlorpromazine did not affect performance at any of the three speeds. At 3.3 rpm mescaline was also without effect. At 6.6 rpm, 50 mg/kg mescaline produced some impairment; 25 mg/kg did not. At 10.0 rpm, both doses of mescaline produced a decrease in running efficiency with the higher dose producing a greater impairment. Locomotor ataxia appeared to contribute to mescaline-induced impairment of forced running at the higher speeds.

3. Effects of mescaline on performance of the CAR.

Rats were trained to perform the CAR in a modified activity wheel. The animals were required to run, at the

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

onset of a visual or auditory CS, in order to avoid a shock. Avoidance of the shock was accomplished by causing the wheel to make a complete (360°) revolution. Training proceeded to a criterion of 10% (or fewer) errors on 2 consecutive test days.

(a) For both auditory and visual CAR there was an increase in the mean number of errors following administration of 5 mg/kg chlorpromazine and 25 and 50 mg/kg mescaline. This increase in errors was statistically significant ($p<.05$) for all animals except those performing the auditory CAR with the lower dose of mescaline.

(b) Irrespective of mode of CS presentation, chlorpromazine produced approximately 75% block of the CAR.

(c) The lower dose of mescaline produced a 24% block of the visually-mediated CAR; responses to the auditory stimulus were unaffected.

(d) The higher dose of mescaline produced a 42% block of the visually-mediated CAR and a 22% block of responses to the auditory CS.

(e) Although the CAR impairment produced by chlorpromazine differs quantitatively from that produced by mescaline, measurements of intertrial activity suggest the further interpretation that these two agents exert their effects in different ways. Chlorpromazine virtually abolished intertrial running; mescaline, at both dose levels, markedly increased it.

4. Effects of mescaline on "running" and "freezing" responses.

Rats were trained to either move continuously ("running") or refrain from moving ("freezing") in order to avoid shock in the activity wheel.

(a) Both running and freezing response patterns were disrupted by 25 and 50 mg/kg mescaline. The larger the dose, the more severe was the effect.

(b) Chlorpromazine (5 mg/kg) produced an increase in the mean number of shocks required to maintain the running response; freezing responses were unaffected.

(c) Mescaline-induced disruption of the freezing response was accompanied by behavioral manifestations which were not observed to occur under any other conditions of testing (e.g. hypermotility, vocalizations, spontaneous jumping, etc.).

Microfilm $2.95; Xerox $10.35. 226 pages.

CYTOTOXICITY OF ANTIBACTERIAL AGENTS

(Order No. Mic 61-2155)

Millard Herbert Ruether, Ph.D.
University of Minnesota, 1961

A study of the relative toxicity of eleven antibacterial substances to rabbit leukocytes in vitro and to healing excisions on the backs of mice in vivo has been described.

Twenty-four hour, hanging-drop plasma clots containing buffy coat fragments from rabbit blood were exposed for one hour to various concentrations of the drugs. Following this exposure, the test solution was removed and the leukocytes were treated with neotetrazolium chloride, a supravital dye, for thirty minutes. Microscopic counts were made to determine the percentage of the cells which were incapable of metabolizing the dye and were, therefore, incapable of producing distinguishable granulation. Approximate LD50 concentrations of the antibacterial substances were determined from this data by employing the graphic method of probit analysis.

These approximate LD50 concentrations were applied daily to eleven individual series of single, three-millimeter excisions made over the right scapulae of white mice. The time required for complete epithelialization of these wounds was noted and compared to control wounds made on other mice and treated with physiological saline solution. The differences between the mean times required for the epithelialization of the treated wounds and the control wounds were tested for significance by application of Student's "t". In the case of each of the eleven series, the prolongation of wound healing was determined to be highly significant.

Excluding the results obtained from the application of supersaturated solutions of Sulfanilamide, NF, and Mafenide Hydrochloride which introduced the complicating factor of mechanical irritation from the presence of crystals, the average difference between the mean epithelialization times in the control and the other nine drug groups was 2.4 days. Five out of the nine drugs displayed differences within 0.1 of this average, which suggests that there might be a correlation between the number of days of delay in complete epithelialization and the percentage of mortality determined in the short-term tissue cultures of leukocytes.

The approximate LD50 concentrations of the eleven drugs were compared with the cytotoxic concentrations of these materials reported in the literature as determined in vitro. The differences and similarities of these concentrations were discussed.

The relation of the results of this study to the clinical application of these drugs to human lesions was also considered.

Microfilm $2.75; Xerox $6.00. 123 pages.

THE EFFECTS OF CERTAIN COMPOUNDS ON EXPERIMENTAL MUSCULAR DYSTROPHY

(Order No. Mic 61-1892)

Nathan Watzman, Ph.D.
University of Pittsburgh, 1961

The purpose of this investigation was to study the effects of certain musculotropic compounds on the muscular coordination and muscle strength of animals inflicted with muscular dystrophy. Atrophic conditions were produced in albino rats of both sexes and New Zealand male rabbits by the use of a vitamin E-deficient diet. Muscle coordination was quantitatively measured in rats by an electrically driven rod on which the animals were forced to perform motor activities. Ability to stay on the apparatus was recorded in seconds. Muscle strength in the rabbit was quantitatively measured by a modified ergograph in which the right hind leg, attached to a spring system, was electrically stimulated to contract. The distance the animal was able to pull the spring device was recorded in centimeters as evidence of muscle strength. Urinary creatine-creatinine ratios were taken periodically

as evidence of muscle wasting. Offspring survival rates of E-deficient female rats were also studied and motor coordination of the offspring was measured using the procedure discussed above. Muscle strength was determined by recording the time the young could stay on a vertical screen cage. The strain 129 dystrophic mouse (dystrophia muscularis, Roscoe B. Jackson Memorial Laboratories, Bar Harbor, Maine) a myopathic mutant strain, was also utilized to determine if the experimental compounds had any beneficial effects on muscle coordination, muscle strength and life span.

In vitro experiments utilizing the diaphragm muscle of normal and dystrophic 129 mice were also performed. Musculotropic compounds were added to the baths and changes in amplitude of contractions noted. In further studies, diaphragm muscles were partially fatigued and per cent recoveries evoked by the compounds noted.

The experimental compounds utilized in vivo were: Norethandrolone (anabolic), Methandostrenolone (anabolic), Digoxin (Digitalis glycoside), Methimazole (antithyroid), Potassium Chloride (ionic), and Methylprednisolone Acetate (corticosteroid).

The experimental compounds used in the in vitro studies were: Ephedrine Sulfate, Ouabain (g-strophanthin), Aminophyllin (Theophylline Ethylenediamine), and Potassium Chloride.

The data of the pilot studies on the albino rat indicated that the Norethandrolone, Methimazole, and Digoxin-treated animals demonstrated a greater ability to perform forced motor activity than the normal control group. Data on the rabbit studies and urinary creatine-creatinine ratios were inconclusive. Norethandrolone, Methimazole, and Digoxin appear to increase the offspring survival rate of vitamin E-deficient female rats. In a dose of 1:1500, Potassium Chloride in vitro evoked a mean increase in the contractions of fatigued diaphragm muscle (strain 129 mouse) of 27.3 per cent and a mean per cent recovery of 33.5. The success of the latter compound was corroborated in in vivo studies. Potassium Chloride (10 mg/kg) temporarily increased the mean rotarod performance times, arrested loss of weight, and prolonged the life span of the strain 129 dystrophic mouse.

Microfilm $2.75; Xerox $5.00. 96 pages.

PHILOSOPHY

THE DEVELOPMENT OF R. G. COLLINGWOOD'S THEORY OF HISTORY

(Order No. Mic 61-1983)

Howard DeLong, Ph.D.
Princeton University, 1960

The thesis of this essay is that Collingwood's theory of history is being unjustifiably ignored by English and American philosophers. The method chosen to substantiate this claim is to survey his writings which relate to the theory of history, assessing one by one their failures and accomplishments. An attempt is then made to compare his work with other contemporary philosophers working in the same field.

The Prologue presents the majority view concerning Collingwood -- namely, that he can be safely ignored -- and suggests understandable but hardly justifiable reasons for this position.

Chapter 1 gives a brief survey of his life, and indicates his brilliance as a young boy, his importance as an historian, and his recurring ill-health.

Chapter 2 examines Collingwood's early theories of history. The first theory, as presented in Religion and Philosophy, is found to be juvenile and easily refuted. The second, which appears in Speculum Mentis, is more sophisticated, but it is found to be inadequate. A subsequent series of early essays show demonstrable improvements, but they (like his earlier theories) are found to be sceptical.

Chapter 3 takes up the Essay on Philosophical Method. It is argued that the Idea of Nature (written shortly after the Essay) is by implication a partial refutation of the Essay. But here for the first time, Collingwood mentions some doctrines about philosophy which will later be incorporated into his mature theory of history.

Chapter 4 considers Collingwood's mature theory. "The Historical Imagination," "Human Nature and Human History," and some other essays written at that time are examined. It is argued that the general purport of this theory (excepting the doctrine that history is a form of self-knowledge) is sound. In particular, Collingwood's central doctrines -- "all history is the history of thought" and "all history is the re-enactment of past thought in the historian's own mind" -- are defended against actual and possible misinterpretations.

Chapter 5 describes Collingwood's theory of art, his doctrine of historical causation, and his "logic of question and answer." His theory of art contains further evidence which refutes the claim that Collingwood's theory of history assumes that the mind has occult powers. It is also argued that his doctrine of historical causation is correct. Finally, it is denied that his "logic of question and answer" can replace traditional or symbolic logic. Rather it is asserted that the doctrine provides a methodology for historical research.

Chapter 6 offers an account of Collingwood's theory of metaphysics. This theory is defended against charges that it is a form of historical relativism. It is further suggested that the central doctrines of Collingwood's theory of history should be understood as metaphysical presuppositions. In light of this, they are re-interpreted and again defended.

Finally, the Epilogue compares Collingwood's theory with a positivistic theory, as represented by such writers as Hempel, White, Nagel, and Popper. This comparison of the two theories is developed with respect to three

questions: (1) How do they compare as descriptions of what historians actually do? (2) How do they compare in terms of their appropriateness and applicability to history? (3) How do they compare as instruments productive of progress in actual historical work? In each case, Collingwood's theory is found superior. In particular it is argued that the plausibility of the positivistic theory depends on ignoring, for example, histories of mathematics, art, and philosophy. Collingwood, on the other hand, can point to examples of his own historical writing whose superiority over all previous work is derived directly from the rigorous application of his own philosophical principles. It is concluded that this rare and significant achievement makes the majority view unjustifiable.

Microfilm $3.25; Xerox $11.50. 251 pages.

FOUNDATIONS OF ACCEPTANCE

(Order No. Mic 61-2061)

George Frederick Rieman, Jr., Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Thomas Patton

The dissertation is the first part of a longer program to relate epistemological notions such as truth and knowledge to assertions and beliefs of social groups. The investigation is being carried out as a semiotical one, that is, one in the general field of study of the interrelationships between language elements, their meanings, and their users.

The dissertation itself carries the program through a detailed axiomatic characterization of the relation accepts that, whose meaning is given approximately by the expression "is asserting sentences conveying that." The assertion of sentences is assumed as a primitive concept.

The first chapter contains an informal description of acceptance as explicandum. The possibility of its usefulness in epistemology is discussed in relation to some views from the philosophical tradition. The relation accepts that is regarded as holding between social elements and language elements; these are informally characterized.

The axiomatization rests on a first order atomistic Boolean calculus; this calculus is set forth in detail in the second chapter. A first order logic, such as those described by Church, is assumed. A significant logical modification is the introduction of a rather strong version of the rule of replacement for bound variables, resulting in connection with the atomism, in an especially adaptable first order system. The treatment includes devices for representing sets and classes, and a non-quantificational arithmetic which can be applied to any finite set whose members have a property definable in the calculus. The representation of sets is influenced by work in the Polish logical tradition, stemming from Leśniewski.

As mentioned, accepts that takes as first argument certain entities called "social elements"; their theory is the topic of the third chapter. These elements are taken to be personnel-temporal complexes; accordingly a theory of temporal elements similar to that due to Woodger and Tarski is included.

Language elements are axiomatized in the fourth chapter. They are taken to be language-proposition complexes, where propositions are represented by certain equivalence-classes of (synonymous) sentences. Certain parts of the theory of language elements are isomorphic to certain parts of the theory of social elements, enabling a much briefer treatment of the former than would otherwise be possible.

The fifth chapter turns to the definition of an expression representing acceptance, based on one representing assertion. A primitive enabling the statement that a certain social element is the source for a certain piece of information about language elements is introduced and used to define an expression representing the circumstance that a certain language element is in the objective language of a certain social element (i.e., a subjective language which is also objective). The definitions are such as to require that whenever a social element accepts, each person of the element does so by asserting in his own objective language.

Also in the fifth chapter, by way of illustrating application of the formal apparatus, reduction sentences characterizing special senses of "doubt" and "believe" are given. An expression representing Martin's notion "accepts" is defined.

Microfilm $4.40; Xerox $15.55. 344 pages.

"WHAT IF EVERYONE DID THAT?"

(Order No. Mic 61-2796)

Jordan Howard Sobel, Ph.D.
University of Michigan, 1961

When an individual is trying to decide what he ought to do, he will sometimes consider the consequences of alternative actions open to him. Such considerations furnish him with what I call particular reasons.

Although it is clear that particular reasons are sometimes relevant, there are other reasons which are problematic though they also cite the consequences of actions. The reasons referred to are those that are typically telescoped into the question "What if everyone did that?" I term such reasons general reasons since they call attention to the undesirability of a general practice rather than a particular action.

The problem of this essay is to decide whether general reasons are relevant to the practical problems of an individual, and, if they are relevant, to show how they are. Scepticism towards general reasons flows primarily from the fact that they cite undesirable results which they neither claim to be causally connected to the agent's behavior nor even likely to occur. How can it be relevant to cite against an action results which are neither likely nor causally related to it?

In Part One of this essay the ordinary behavior of general reasons is considered in detail. After developing a number of examples of general reasons, the logic of the evaluation of a general practice is explored. Then the process of delineating the general practice is discussed; it is clear that when we ask what would happen if everyone did that, we mean everyone like the agent and in a similar situation. Even if general reasons are sometimes relevant, they are not relevant always--the question "What if everyone were a postman?" would not ordinarily be taken

as telling against being a postman--thus we also discuss the restricted application of general reasons and attempt to mark off the absurd ones from the plausible ones. Another matter which is taken up in Part One is the very possibility of a general reason which does not simply reinforce particular reasons; it is shown how an undesirable general practice can consist entirely of desirable particular actions.

In Part Two of this essay we develop and criticize several analyses of general reasons, several ways in which one might think that they get their relevance. There are three main approaches. One might think that the key to general reasons is to be found in the logical fact that I ought to do whatever someone like me in all practically relevant respects ought to do. Or it might be felt that if it would be undesirable for everyone to do A, then anyone can see that--in view of the imperfections of reason and the tendencies to personal bias--he ought to make it a principle never to do A irrespective of the particular circumstances. And finally there are those who would say that the ground for general reasons lies in the concept of fairness. These three lines are each developed and found inadequate.

The main conclusion drawn is that general reasons are not relevant to the practical decisions of individuals. In fact, these reasons are not relevant to anyone, but the fact that they are irrelevant is of legitimate interest to the judge and the legislator since these functionaries are in a position to prevent the undesirable general practices which are futilely cited in general reasons. A second related conclusion drawn concerns the proper relation of law to morality. It is shown that law can quite properly not only reinforce but also supplement morality. In particular, law can legitimately correct the dictates of practical reason or morality when it would be undesirable for everyone to follow these dictates.

Microfilm $4.15; Xerox $14.65. 323 pages.

PHYSICS

PHYSICS, GENERAL

THEORETICAL AND EXPERIMENTAL ANALYSIS OF NETWORKS OF RESONATORS AND THEIR APPLICATION TO THE PRODUCTION OF SOUND BY THE VOCAL TRACT

(Order No. Mic 60-4429)

Vernon F. Albert, Ph.D.
Temple University, 1951

In the past all analyses of the vocal tract assumed systems of one or two resonators. However, the x-ray photographs of Russell show that the shape of the vocal tract changes with the expansion or contraction of the cavity walls. Various configurations with as many as four cavities are found to exist in the utterance of vowels. Although the possibility of more than two cavities has been mentioned by some investigators the author has not been able to find in the literature any actual calculations or data of such systems. Also, the mechanical model of the vocal tract and the physiological sensations experienced in speech lead to the belief that the cavities below the vocal cords have to be considered. The vocal cords cannot vibrate unless there is a flow of air between them and therefore an opening; thus, there must be a coupling between the upper and lower systems. Consequently, a mathematical treatment is made for each of the four configurations of the vocal tract including the upper and lower cavities.

The general procedure of vibrational theory affords a convenient solution to the problem. The equations of motion of the network are obtained by application of Lagrange's method to the kinetic and potential energies of the fluid displacements in the constrictions between resonators. Then the equation for the frequencies of resonance of the system is obtained by placing the coefficients of the displacements equal to zero.

The calculations yield a number of resonances equal to the sum of the distinct cavities in the system. Therefore the number of formants in a vowel varies with the configuration of the vocal tract. The dependence of the formant frequencies upon the configuration and dimensions of the resonators is treated in some detail in the dissertation. In general, it is found:

(1) An increase in the diameter of any constriction in the vocal tract increases the frequencies of the formants.

(2) An increase in the length of any constriction in the system decreases the formant frequencies.

(3) An increase in the volume of any cavity in the system decreases the formant frequencies.

Furthermore, the calculations show the frequencies of resonance are dependent upon the relative dimensions of a system rather than upon its absolute dimensions. Hence all systems proportionally equal have formants of the same frequencies.

The large number of parameters involved in the calculations make it possible to have more than one configuration of the vocal tract for a given formant spectrum. Also, the modes of vibration are seen to depend upon the system as a whole. That is, in most cases the uncoupled natural frequencies of the separate cavities are very much different from the frequencies of the coupled system. The relative fluid displacements in the various constrictions are found to differ considerably. This accounts for the different physiological sensations experienced in the vocal tract during the utterance of the so called head and chest tones — such terms are of course misnomers.

Since the basic theory is rigorously applicable only for

wave lengths small in comparison to the size of the resonators, the frequencies for the higher modes of vibration had to be experimentally verified. For this purpose a mechanical vocal tract was constructed consisting of a group of cylindrical resonators variable in configuration and dimensions. The results show that both the general theory and the relations are equally valid for all the modes of vibration for systems of the dimensions used in this work. Hence, the formant frequencies of most vowels may be calculated from the vocal tract dimensions by treating the system as a network of resonators.

Microfilm $2.75; Xerox $5.80. 117 pages.

INTERACTION OF A SHOCK WAVE WITH A STEP BOUNDARY LAYER OF HIGH SOUND SPEED GAS

(Order No. Mic 61-2371)

Ralph Leslie Haslund, Ph.D.
The Pennsylvania State University, 1961

The interaction of a plane shock wave with a step boundary layer of high sound speed gas has been investigated. The experimental system consisted of a shock tube with a test section made to contain gas tight cells bounded by thin collodion films. The step boundary layer of high sound speed gas was formed by replacing the air in one of the test section cells by nearly pure hydrogen. The interaction process was observed by means of a Mach-Zehnder interferometer.

Although only the early stages of the interaction process were observable, data were obtained to allow a detailed analysis of this phase of the interaction such that the main features of the interaction in its later stages could be predicted.

Analysis is given of the transition process, immediately after initial refraction, resulting in a curvature and change of strength of the transmitted wave, the pressure and flow conditions associated with the formation of a retransmitted compression wave, the effects of the retransmitted wave flow on the slow shock just above the boundary layer, the nature of the pressure readjustment leading to evolution of the interaction configuration, and an experimentally realistic indication of the stagnation conditions in the transmitted wave flow. Results are compared with those obtained by other investigators for the interaction of a shock wave with a diffuse boundary layer of high sound speed gas under similar initial conditions.

Microfilm $2.75; Xerox $4.40. 82 pages.

FORMATION OF NEGATIVE IONS IN CO BY CHARGE TRANSFER

(Order No. Mic 61-1870)

Farid Hushfar, Ph.D.
University of Pittsburgh, 1961

The electron loss and capture cross sections for fast hydrogen atoms incident in argon and carbon monoxide have been measured in the energy range 8-40 Kev. In the case of argon, the cross sections are found to vary smoothly with energy. In the second case, however, the measurements have revealed structure in both cross sections. The enhancement of the loss cross section at certain hydrogen atom energies has been attributed to capture of the stripped electron by the target CO molecule to form states of the negative molecular ion according to the Franck-Condon principle. Assuming that the electron acquires a small amount of kinetic energy in the center of mass of the incident hydrogen atom and appears as though it were a free electron, it was possible to correlate the onset of the peaks in the electron loss cross section and the appearance potentials for negative ions in CO.

In a mass spectrographic analysis of the residual ions carried out so far, the negative ions have appeared as predicted. The ion formed at the incident beam energy of 12 Kev is predominantly CO^-. At 13.07, 13.75, 14.34, 16.29 and 17.42 Kev the negative ion is predominantly O^-. At these energies another ion has appeared which has been identified as an O^- ion due to the breakup of a loosely bound CO^- ion before it enters the analyzing magnetic field. At 30.71 and 33.82 Kev an ion of mass number 20 has been observed which presumably is a fast C^- or O^- ion. C^- first appears at 33.82 Kev.

At 12 Kev the cross section for formation of negative ions has been roughly measured to be 10^{-16} cm^2. Relative measurements of this cross section at other energies have revealed that it varies in the same way as the electron loss cross section.

The method for production of negative ions by charge transfer seems to be the most efficient way discovered so far. Microfilm $2.75; Xerox $4.20. 76 pages.

EXPERIMENTAL STUDIES OF PROPAGATION DISTORTION OF FINITE AMPLITUDE NOISE

(Order No. Mic 61-2392)

Fujio Oda, Ph.D.
The Pennsylvania State University, 1961

This is a summary of a study of the propagation distortion of band limited acoustic noise.

A theoretical analysis for the half-octave band of noise made by Ackerman and Burnett (1959) predicted that the finite amplitude effects which may occur within three meters from a sound source could appear in several distinctive ways depending on the sound pressure and the frequency. For a relatively low sound pressure level, the existence of three regions, namely a, b, and c on the pressure vs frequency diagram, was predicted. Region a was designated for the area where the infinitesimal solution is valid, or where no finite amplitude effects would be observed. In region b a pronounced build-up of difference frequencies occurs whereas no significant sum frequency build-up takes place. In region c, both difference and sum frequency build-ups were predicted.

A noise signal with an over-all pressure level of 132 db (in a half-octave band centered at about 25 kc) was produced by using the Ionophone, a non-resonant type transducer. Details of the apparatus used in these studies are

described; the major equipment items include an electronic filter, a frequency analyzer, and a pipe in which plane wave noise signals are produced.

By using a ceramic probe microphone, the frequency spectrum of the noise band signal was analyzed as a function of distance from the transducer. No significant changes were found in either the sum or the fundamental frequency spectrum. On the other hand, it was established that a very pronounced build-up of difference frequencies occurs in the 0.6-4.8 kc band. This region corresponds to region b where the dissipative terms over-ride the effect of non-linearities at sum frequencies. However, if any difference frequencies are generated by non-linearities, these are only moderately attenuated. At a 10 db lower over-all noise pressure level, no propagation distortion was found.

Although no clear cut evidence existed for the generation of sound energy at the sum frequencies, 40-60 kc, there was an indication that the attenuation was lower at these frequencies when the fundamental sound pressure level was higher. This suggests that 132 db is just below the dividing line between region b and region c. In the latter, the non-linear effects are comparable to the dissipation which allows the build-up of energy at the sum frequencies. However, iterated shock cannot be formed in region c.

These results are in agreement with a theoretical analysis which predicted such regions and which also predicted the existence of a fairly distinctive boundary which separate the regions where infinitesimal approximations are valid and the regions where non-linearities generate difference frequencies but do not build-up sum frequencies.

Microfilm $2.75; Xerox $3.80. 69 pages.

PHYSICS, ELECTRONICS AND ELECTRICITY

A STUDY OF THE TIME LAG OF GAS BREAKDOWN IN REVERSED ELECTRIC FIELDS

(Order No. Mic 61-2236)

Harry White Kendall, Ph.D.
The University of Florida, 1961

Previous investigations of the gaseous breakdown mechanism have established the electron avalanche as the prime process by which a gaseous plasma is created, and have shown that the space charge created by the avalanche build-up is an important factor in the ultimate electrical breakdown of the gas. The creation of a sustained filament of gaseous plasma between the electrodes of a discharge gap constitutes the electrical breakdown of the gas since the conductivity within the filament has achieved a value that enables the current flow to be a function of the external circuit only.

During the electron avalanche build-up, and before the gas has achieved the state that could be referred to as a plasma, the space charge of the avalanche creates an electric field that may be of the order of magnitude of the applied electric field, and, therefore, greatly influences its own build-up. In cases where the gaseous discharge gap is subjected to the very small over-voltages (less than 0.05%) the formative time lag shows that many electron avalanches traverse the discharge gap before the gas achieves the plasma condition of gaseous breakdown. The relatively slow build-up of space charge by each succeeding avalanche again produces a space charge electric field that influences the behavior of the subsequent avalanches.

The present work was undertaken in order to determine experimentally at least one of the effects of this space charge created electric field on the behavior of the subsequent breakdown process. The experiment was designed so that the direction of the applied electric field could be reversed after a space charge build-up had begun in the discharge gap. The time required for the reversal of the applied electric field was about one-hundredth of the formative time lag of the discharge gap that was being studied. The time lags measured after the applied electric field had been reversed were measured from the time of reversal to the time of electrical breakdown of the gas and such time lags have been termed partial time lags since they are neither statistical nor formative time lags.

The space charge electric field created by the avalanche or avalanches occurring before the reversal of the applied electric field may be in the same direction as the initial applied electric field in some regions of the discharge gap and may be in a direction that opposes the initial applied electric field in other regions of the discharge gap. Partial time lags that are shorter than the corresponding formative time lags for the same discharge gap conditions would indicate that the space charge electric field has a net effect of hindering the breakdown process in an applied electric field that was not reversed. If the creation of the plasma requires longer partial time lags than the corresponding formative time lags, then the space charge effect enhances the breakdown process during the formative time lag.

Partial time lags measured at atmospheric pressure with small over-voltages in a uniform electric field produced by a difference of potential of approximately 10,000 volts indicate that if a space charge build-up occurs, it must occur during the very last part of the formative time lag and that practically no space charge build-up occurs during the first 95% of the formative time lag. Experiments performed at reduced pressures and in nonuniform electric fields at atmospheric pressure gave partial time lags which indicated that the space charge created by burst pulses and pre-onset streamers definitely hinder the development of the breakdown process in an electric field which is not reversed. The space charge created by such processes gave a threshold voltage necessary to produce the reversed electric field, a value that was more than 25% below the threshold voltage necessary to produce the initial electric field.

Microfilm $2.75; Xerox $5.60. 113 pages.

PHYSICS, NUCLEAR

ANALYSIS OF SOME DEUTERON-INDUCED REACTIONS IN OXYGEN – 18

(Order No. Mic 61-1854)

James Calvin Armstrong, Ph.D.
University of Pittsburgh, 1961

The reactions $O^{18}(d,t)O^{17}$, $O^{18}(d,d')O^{18*}$, and $O^{18}(d,p)O^{19}$ are studied using 15-Mev deuterons and magnetic analysis of reaction particles. Absolute cross sections are determined to an accuracy of about 25 per cent for all reactions studied and the Butler-Born approximation is used to extract reduced widths when possible. Angular distributions of triton groups corresponding to the ground, 0.871-, 3.846-, 4.555-, 5.083-, and 5.378-Mev states of O^{17} are obtained. An estimate of the configuration admixtures in the O^{18} ground state is made from analysis of the reduced widths and indicates the presence of a sizeable (about 6 per cent) $(1f_{7/2}^2)_0$ component. The experimentally determined admixtures are compared with several theoretical estimates. All O^{18} levels observed in the inelastic deuteron scattering have been previously reported – the known 5.01-Mev state is not observed. The angular distribution of inelastic deuterons corresponding to the first excited state of O^{18} is obtained and comparison of the absolute cross section with theory provides an estimate of the O^{18} deformation. Proton groups from $O^{18}(d,p)O^{19}$ reactions are observed corresponding to O^{19} excitations of 0, 1.469, 3.164, 3.948, (4.123), (4.586), (4.706), (5.165), 5.45, 5.707, and 6.279 Mev. The assignment of the levels in parentheses to O^{19} is not certain. The known 0.096-Mev state is not observed. Levels above 4-Mev excitation have not been previously reported. The proton group corresponding to 5.45-Mev excitation contains contributions from at least two states in O^{19}. Angular distributions of (d,p) reactions leading to the O^{19} ground, 1.469-, 3.164-, 3.948-, 5.707-, and 6.279-Mev states are obtained and reduced widths extracted. The ℓ_n values for these angular distributions are ambiguous except for the ground state reaction ($\ell_n = 2$) and the 1.469-Mev state reaction ($\ell_n = 0$). Analysis of the reaction data suggests that J^π (ground state) = $5/2^+$ and J^π (0.096-Mev state) = $3/2^+$. Using parameter values estimated from the O^{19} energy level spectrum and obtained from neighboring nuclei, a description of this nucleus in terms of the strong-coupling unified model is shown to agree with the reaction data.

Microfilm $2.75; Xerox $4.20. 80 pages.

DIRECTIONAL CORRELATION OF SUCCESSIVE GAMMA RAYS IN Ba^{136} AND Mo^{94}

(Order No. Mic 61-2522)

Hyman Bernstein, Ph.D.
University of Southern California, 1961

Chairman: Professor Forster

In recent years it has been shown that among the even-even nuclei there exist two main groups with characteristically different properties, as regards the total angular momentum (or "spin"), energies of the first and second excited states, and multipolarity of the radiation emitted in the de-excitation process. For the class of medium weight nuclei, for which $24 \leq N \leq 88$, the first excited state has always the character (spin and parity) 2^+, whereas the second excited state character is predominantly 2^+, with 0^+ and 4^+ occurring occasionally. The radiation emitted in the 2-2 transition is composed of an E2-M1 admixture, with enhanced E2.

In the present work the transition from the second excited state has been investigated for the medium weight radioisotopes Ba^{136} and Mo^{94}. For this purpose the directional correlation of successive gamma rays was utilized. The apparatus used was a scintillation crystal spectrometer, using two $1\frac{1}{2}$" x $1\frac{1}{2}$" thallium-activated sodium iodide crystals. The resolving time of the instrument was 16 millimicroseconds. The radioactive sources used were Cs^{136} (13 days) and Nb^{94} (1.8×10^4 years), which decay by negative beta emission to Ba^{136} and Mo^{94}, respectively. The directional correlation has been measured for the 1065 KeV–830 KeV coincident gamma rays in Ba^{136} and the 700 KeV–874 KeV cascade in Mo^{94}, which correspond to transitions from the second to first excited, and first excited to ground state, respectively.

The directional correlation function is given in terms of a Legendre polynomial expansion as:

$$W(\theta) = 1 + A_2P_2(\cos\theta) + A_4P_4(\cos\theta)$$

where the expansion coefficients are functions of the spins of the levels and multipolarities of the emitted radiations.

The experimental determination of the expansion coefficients, after correction for the finite solid angle of the detectors, gave: $A_2 = 0.1238 \pm 0.0161$ and $A_4 = 0.0014 \pm 0.0152$ for Ba^{136}; $A_2 = 0.0865 \pm 0.0080$ and $A_4 = 0.0243 \pm 0.0125$ for Mo^{94}. Both these results are compatible with either a $4^+(Q)2^+(Q)0^+$ or a $2^+(D+Q)2^+(Q)0^+$ assignment, with the latter giving better agreement.

Assuming mixing in the upper transition, an analysis gave the quadrupole content as $2.7 \pm 0.6\%$ for Ba^{136} and $4.4 \pm 0.4\%$ for Mo^{94}.

Although the $2^+ - 2^+ - 0^+$ character assignment led to a weak E2 admixture in the 2-2 transition, in contradiction to the majority of even-even nuclei it has been suggested that the M1/E2 intensity ratio tends to increase with decreasing nuclear deformation. In terms of the deformation parameter, x, the present results for both nuclei indicate that $x < 0.25$.

A plot was made of δ, defined as $\delta \equiv \sqrt{E2/M1}$, as a function of the neutron number, utilizing all available data on nuclei possessing a $2^+ - 2^+ - 0^+$ character assignment. It is observed that for nuclei removed from the magic numbers δ becomes large and near the magic numbers, where the nuclei are considered as being slightly deformed, $\delta < 1$.

Microfilm $2.75; Xerox $5.60. 114 pages.

(d,p) AND (d,t) REACTIONS ON THE SILICON ISOTOPES

(Order No. Mic 61-1861)

Allen Guyan Blair, Ph.D.
University of Pittsburgh, 1961

The 15-Mev deuteron beam of the University of Pittsburgh fixed-frequency cyclotron was used to bombard natural silicon targets and targets enriched in Si^{29} and Si^{30}. The reaction products were magnetically analyzed and detected in nuclear emulsions or in a scintillation counter. Angular distributions of protons from Si^{29}, Si^{30}, and Si^{31} levels up to excitation energies of approximately 6 Mev were obtained. From the comparison of Butler-Born-approximation curves to the angular distributions, ℓ values and reduced widths for the transitions were determined. Angular distributions of tritons were obtained for the $Si^{29}(d,t)$ reaction to the ground and first excited states of Si^{28}, and for the $Si^{30}(d,t)$ reaction to states up to an excitation energy of 5.5 Mev. Butler-Born curves were also compared to these distributions and reduced widths were extracted. From the experimental results the predictions of the strong-coupling model, with Nilsson wave functions, can be tested. The Si^{29} nucleus has previously been shown to be quite well represented by the strong-coupling model. It is not clear from the present experiment that the Si^{30} and Si^{31} nuclei can be described in terms of this model, but to the extent that the description is valid these nuclei appear to have prolate equilibrium deformations, contrasted to the oblate deformations possessed by the Si^{28} and Si^{29} nuclei. It is shown that the ground-state wave function of Si^{30} cannot contain more than approximately 15% $1d_{5/2}$ closed shell.

Microfilm $2.75; Xerox $5.60. 115 pages.

THE LONGITUDINAL POLARIZATION OF ELECTRONS FROM Pm^{147}

(Order No. Mic 61-2203)

Chellis Chasman, Ph.D.
Columbia University, 1961

The longitudinal polarization of the electrons emitted in the decay of Pm^{147} was investigated by the method of Mott scattering. A straight line spectrometer using crossed electric and magnetic fields was built to analyze the energy of the electrons and to rotate their spin relative to their momentum from zero to 2π radians. The polarizations obtained for a 90° spin rotation are in fair agreement with that expected on the basis of the two component theory of the neutrino. For greater rotations higher field strengths are required, and it is suspected that the fringing fields introduce asymmetries not adequately corrected for by the normalizing aluminum foil. There is a discussion of the validity of this type of normalization and of the other errors that might arise in determining the polarization by Mott scattering.

Microfilm $2.75; Xerox $5.80. 119 pages.

FAST-NEUTRON TOTAL CROSS SECTIONS OF BERYLLIUM, CARBON, AND OXYGEN.

(Order No. Mic 61-2866)

David Bruce Fossan, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor H. H. Barschall

The total neutron cross sections of beryllium, carbon, and oxygen were measured from 3.4 to 16 MeV neutron energy by a transmission experiment in good geometry. Neutrons below 7 MeV were produced by bombarding an about 20-keV thick zirconium-tritium target with protons from a tandem electrostatic accelerator. Above 7 MeV (d-d) neutrons of about 40 keV energy spread were produced in a gas target. A stilbene scintillator with pulse shape gamma-ray discrimination served as a biased proton recoil detector. Except for a small anomaly near 4.3 MeV the beryllium cross section decreases slowly with energy from 1.9 barns at 4.5 MeV to 1.4 barns at 16 MeV. Several sharp peaks were observed in the carbon cross section below 8.5 MeV; above this energy the carbon cross section shows only slow variations with small amplitudes. The oxygen cross section exhibits below 9 MeV sixteen resonances with widths less than 100 keV. Above 9 MeV the oxygen cross section varies slowly with energy. The behavior of the cross sections for each of the three elements is similar in that no sharp peaks occur above an excitation energy of about 12 MeV in the respective compound nucleus.

Microfilm $2.75; Xerox $4.60. 87 pages.

SEARCH FOR A π°

(Order No. Mic 61-2034)

Marvin William Gettner, Ph.D.
University of Pennsylvania, 1961

Supervisor: Dr. Walter Selove

The energy distribution of neutrons from the charge exchange reaction $\pi^- + p \rightarrow \pi^\circ + n$ has been studied, for π^- mesons stopped in liquid hydrogen, to investigate the possible existence of a second π° with mass within a few Mev of the "ordinary" π°. The neutron energy was measured by a time of flight technique using a vernier chronotron and an oscilloscope system. No neutron group corresponding to a second π° was seen. The sensitivity of the measurement was such that a second group of relative intensity above 10-20% would have been seen for a second π° with a mass in the range between about 2/3 Mev and 2 Mev away from the mass of the ordinary π°.

From the time of flight of the charge exchange neutrons, which was measured at distances of 2, 2-1/2 and 3 ft, a value of 9.0 ± 0.5 electron masses was obtained for the $\pi^- - \pi^\circ$ mass difference. The data also give a lower limit to the π° lifetime: $\tau > 3 \times 10^{-21}$ sec.

Microfilm $2.75; Xerox $6.80. 142 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

FAST NEUTRON-NUCLEUS INTERACTIONS

(Order No. Mic 60-5383)

Donald Wetherald Kent, Jr., Ph.D.
Temple University, 1960

An experimental investigation of the interactions of mononergetic neutrons with nuclei of intermediate atomic weight has been made in order to further fix the validity and parameters of a diffuse-edge optical model potential. Angular distributions of the differential cross section for elastic scattering of 3.7 Mev neutrons have been determined for four elements in the middle atomic weight region. Integration of this measurement combined with a total cross section measurement yields a value for the non-elastic cross section which is compared with optical model predictions, thereby determining the extent to which compound elastic scattering is present.

The source of neutrons is obtained from the reaction resulting when deuterons, accelerated by a Van de Graaff generator to an energy of 1.0 Mev, impinge on a target of deuterium gas. The energy spread of the resulting neutron flux is 400 Kev, which is sufficient to permit averaging over resonances and therefore to satisfy the conditions for use of the optical model. The scattering samples consisted of annular rings and cylinders of potassium, selenium, germanium, and zirconium. Neutrons were detected by a scintillating organic crystal which permits high angular resolution and low contribution to background. Reduction of the data included pulse height analysis, angular resolution correction and an approximate analytical correction for multiple scattering.

A new detector was developed for the purpose of investigating spin-orbit coupling through polarization measurements. Its directional character increases the ratio of scattered counts to background counts. Left-right assymetry measurements of the scattering of partially polarized 3.1 Mev neutrons were made using carbon as an analyzer. Microfilm $2.75; Xerox $7.00. 147 pages.

STUDY OF K^+N SCATTERING IN THE DOUBLE DISPERSION REPRESENTATION

(Order No. Mic 61-2047)

Benjamin Whisoh Lee, Ph.D.
University of Pennsylvania, 1961

Supervisor: Abraham Klein

K^+N scattering is studied using the double dispersion representation and stressing the analyticity, crossing relations and unitarity of the scattering amplitudes. Dispersion relations of the partial wave amplitudes are recorded and the method for computing the discontinuities across the unphysical branch cuts is shown. An approximate reduction of the double dispersion representation to a single integral representation is carried out along the line suggested by Cini and Fubini, and the physical significance of the resulting representation is explained.

The partial wave dispersion relation is applied to the $s_{\frac{1}{2}}$ states both in the T = 1 and 0 states. A brief survey of the phenomenology of K^+N scattering is presented. We represent by a phenomenological parameter (essentially the scattering length) the effects of the short range forces associated with the crossed process $N + \bar{K} \rightarrow N + \bar{K}$ and higher mass intermediate states in the channel $K + \bar{K} \rightarrow N + \bar{N}$ which are expected to be energy insensitive. The longest range force due to the exchange of two pions between the nucleon and K-meson is then assumed to be most responsible for the energy dependence of the K-matrix. Recent advances in the study of the $\pi\pi$ interaction and the electromagnetic structure of the nucleon enable us to estimate the strength of this force. Here we adopt the point of view that the virtual process $\pi + \pi \rightarrow K + \bar{K}$ below the threshold is strongly enhanced in the T = 1, J = 1 state because of the $\pi\pi$ resonance in the corresponding initial state, and that the resonance is describable by the parameters of Frazer and Fulco deduced from the electromagnetic structure of the nucleon. The possibility of the strong 3 pion exchange mechanism is disregarded in the present study.

The effect of the hyperon exchange between the nucleon and kaon is discussed. The hyperon exchange gives rise to a force of range about one eighth of a pion Compton wave length. This force is very weak even with the relevant coupling constants as large as the pion-nucleon one.

We solve the dispersion equation for the $s_{\frac{1}{2}}$ state. Parameters introduced in our theory are determined to fit the phenomenological effective range relation. We find that in the T = 1 state the long range force is attractive while the short range force is strongly repulsive; in the T = 0 state, the long range force is repulsive and the short range force is weakly attractive. The strength of the long range force we deduce here agrees with that obtained by Ferrari, Frye, and Pusterla for K^-N scattering as regards the sign and order of magnitude.

We use two methods for representing the short range effects phenomenologically: first, we made a subtraction in the dispersion relation at the threshold; second, we place a phenomenological pole at the origin of the complex W (c.m. total energy) plane. In the second method it is possible to estimate the magnitude of the $p_{\frac{1}{2}}$ amplitude on the basis of the reflection relation of the $s_{\frac{1}{2}}$ and $p_{\frac{1}{2}}$ amplitudes first noted by McDowell. From this consideration certain predictions are made on the $p_{\frac{1}{2}}$ amplitudes which are as yet uncertain experimentally.

Microfilm $2.75; Xerox $8.00. 175 pages.

AN INVESTIGATION OF THE NUCLEAR REACTIONS $C^{12}(\alpha,p)N^{15*}$, $Al^{27}(\alpha,p)Si^{30*}$, and $P^{31}(\alpha,p)S^{34*}$ AT 42 MEV.

(Order No. Mic 61-2101)

Albert John Lieber, Ph.D.
University of Washington, 1961

Chairman: Fred H. Schmidt

Angular distributions of proton peaks corresponding to single and multiple levels of excitation have been obtained for the reactions $C^{12}(\alpha,p)N^{15*}$, $Al^{27}(\alpha,p)Si^{30*}$, and $P^{31}(\alpha,p)S^{34*}$ at 42 Mev. incident alpha energy. The distributions corresponding to the ground state transition and third

excited state in the carbon reaction, and the ground state and first excited state in the phosphorus reaction show pronounced diffraction-like structure. The distributions corresponding to the ground state transition and first excited state in the aluminum reaction show a marked lack of structure.

These angular distributions are compared with the theoretical predictions of various direct interaction mechanisms, and fair fits are obtained for the ground state transitions in the carbon and phosphorus reactions. The theory is incapable of matching even the positions of the peaks for the third excited state in the carbon reaction.

Microfilm $2.75; Xerox $5.40. 110 pages.

NUCLEAR REACTION STUDIES AT INTERMEDIATE ENERGIES. (PARTS I AND II).

(Order No. Mic 61-1325)

David Keith McDaniels, Ph.D.
University of Washington, 1960

Chairman: George W. Farwell

Part I of this thesis describes experiments on the scattering of alpha particles and deuterons by complex nuclei. In the first section of Part I angular distributions are presented for elastic and inelastic scattering of 41-Mev alpha particles by Ti^{48}, Fe, Ni, Zn, Zn^{64}, and Sr. In all targets excitation by inelastic scattering is strongest for the low-lying 2+ levels, usually described in terms of quadrupole surface vibrations, and for the "anomalous" levels of somewhat higher excitation. The results for both elastic and inelastic scattering are analyzed in terms of a strong absorption diffraction scattering model. Parameters associated with collective interpretations of both types of levels are estimated and compared with values of the corresponding quantities derived from Coulomb excitation and electron scattering experiments. Reasonable agreement is obtained in the quadrupole excitation analyses. Strong support is given for 3^- assignments for the anomalous levels and for their interpretation in terms of surface octupole vibrations.

The second section of Part I describes the diffraction analysis of elastic and inelastic scattering by magnesium. Angular distributions for elastic scattering by Mg and inelastic scattering proceeding to the 1.37-Mev 2+ state in Mg^{24} have been measured for alpha particles of 41, 34, and 28 Mev incident energy and for deuterons of 21 Mev incident energy. These results as well as those obtained previously by other workers have been analyzer in terms of a diffraction scattering model. This model predicts that the elastic and inelastic differential cross sections, if divided by K^2, should each follow a single function of $2KR_o \sin \theta/2$ for all energies of the incident particles. Reasonable agreement between calculated and observed "universal" curves for alpha particle scattering lends support to this model. Normalization of the experimental and theoretical universal curves for inelastic scattering leads to a value for the absolute magnitude of the equilibrium deformation parameter, $|\beta_2|$, of 0.24.

Part II of this thesis describes the design, construction and preliminary testing of a 23 ton heavy particle magnetic spectrometer. The importance of this instrument lies in its high resolving power. This part was written in a manner which, it was hoped, would be of the most utility to future users of the magnet. A complete description of the pertinent magnet theory is given. The spectrometer is of the single-focusing broad-range type having a first order directional focal surface which allows simultaneous focusing of heavy charged particles within a range of energy $0.5\ E_o$ to $1.1\ E_o$. (E_o is the particle energy for 90° deflection with the optimum radius of curvature of 35.55 inches.) At the maximum expected operating magnetic flux density of 13 kilogauss, E_o is approximately 65 Mev for protons or alphas. The inherent momentum resolution will be equal to or better than

$$\frac{\Delta p}{p} = \frac{1}{2000}$$

for a solid angle of 0.0007 steradians, i.e., for an acceptance angle of approximately ± 2° in a plane parallel to the gap midplane. (This is also the scattering plane and is horizontal.) The maximum useful horizontal acceptance interval is ± 4°. Some adjustment of the gap was necessary to obtain a magnetic flux density uniform to about one part in 4000, twice as good as the required values quoted above. Initial tests with a Po^{210} natural source indicate that the performance of the magnet will be adequate.

Microfilm $3.40; Xerox $11.95. 262 pages.

NUCLEON-NUCLEON (L·S) INTERACTION FROM NUCLEON SPIN 3/2 ISOBAR MODEL

(Order No. Mic 61-2493)

Larry Mark Noble, Ph.D.
Purdue University, 1961

Major Professor: M. Sugawara

The nucleon-nucleon potential has been previously deduced from pion field theory to fourth order in the pion-nucleon coupling constant for both pseudoscalar and pseudovector coupling. The contribution of higher-order diagrams to the static part of the nucleon-nucleon potential has also previously been estimated by the technique of using a particle of spin and isotopic spin 3/2 to approximate the (3/2, 3/2) resonance observed in pion-nucleon scattering experiments. Here this same technique is used in estimating the higher-order contributions to velocity-dependent terms in the potential. The Tamm-Dancoff expansion is used. The result is an (L·S) potential of the order of magnitude, at most, of the (L·S) potential obtained from perturbation theory to fourth order, and of positive sign in both even and odd states. Therefore, the over-all pion field theoretical (L·S) potential appears to remain substantially smaller in magnitude in the triplet-odd state than the phenomenological (L·S) potential of Gammel and Thaler. Microfilm $2.75; Xerox $5.60. 113 pages.

VELOCITY-DEPENDENT NUCLEAR FORCES

(Order No. Mic 61-2128)

Mohsen Modarres Razavy, Ph.D.
Louisiana State University, 1961

Supervisor: Professor J. S. Levinger

The two-nucleon interaction is assumed to be a well-behaved potential which consists of a static attractive and a velocity-dependent part which is a quadratic function of momentum.

The following forms have the required invariance properties:

$$\hat{V}_1 = -V_0\, J_1(r) - \frac{\lambda}{M}\, \vec{p}.J_2(r)\, \vec{p}$$

$$\hat{V}_2 = -V_0\, J_1(r) - \frac{\lambda}{2M}\, [\, \vec{p}^{\,2}\, J_2(r) + J_2(r)\, \vec{p}^{\,2}\,]$$

With these potentials the Schrodinger's equation can be solved analytically (neglecting the Coulomb force) if J_2 is chosen to be a square well and J_1 a square well on a combination of a square well and Jost's potential. There are three or four adjustable parameters to fit the low energy data and the phase shifts of ^1S and ^1D from 20 to 340 Mev. If the interaction is assumed to be of the form V_1 then:

(i) For two identical square wells

$$-J_1(r) = -J_2(r) = U(r-b) - 1$$

the ^1S phase shifts are in fair agreement with the Breit's analysis of the experimental phase shifts, but for ^1D the fit is poor. ($U(r-b)$ the Heaviside unit function.)

(ii) For $-J_2(r) = U(r-b) - 1$ and

$$-V_0\, J_1(r) = \frac{2\hbar^2 v e^{-\mu b} \mu^2}{M(1-v e^{-\mu b})^2}[U(r-b)-1] + \frac{2\hbar^2 v \mu^2 e^{-\mu r}}{M(1-v e^{-\mu r})^2}\, U(r-b)$$

the ^1S fitting is excellent. To calculate ^1D phase shifts Born approximation has been used, and the results agree fairly well with Breit's phase shifts up to 180 Mev.

Analytical results are presented for the form $\hat{V}_2$, but no numerical results are given.

Microfilm $2.75; Xerox $3.80. 68 pages.

MEASUREMENTS OF $N^{14} + \alpha$, $O^{16} + He^3$, AND $O^{16} + \alpha$ DIFFERENTIAL CROSS SECTIONS.

(Order No. Mic 61-2869)

Edward Allen Silverstein, Ph.D.
The University of Wisconsin, 1960

Supervisor: Professor Hugh T. Richards

A differentially pumped gas scattering chamber was used with the Wisconsin 4 MeV Electrostatic Accelerator in the measurement of $N^{14} + \alpha$, $O^{16} + He^3$, and $O^{16} + \alpha$ differential cross sections.

The $N^{14}(\alpha,\alpha)N^{14}$ differential cross sections were measured with thin (~2 keV) gas targets for E_α between 1 and 2.4 MeV. The energy range was surveyed at θ(c.m.) = 169°58', and data were taken in the region of resonances at θ(c.m.) = 169°58', 140°46', 125°16', 90°, and 54°44'. Resonances, corresponding to levels in F^{18} were observed at E_α = 1.52, 1.63, 2.16, 2.35, and 2.37 Mev. These levels were found to be formed by ℓ = 1,1,3,3,0 alphas respectively. Approximate widths were also assigned.

The $O^{16}(He^3,He^3)O^{16}$ differential cross sections were measured over a laboratory He^3 energy range from 1 to 3.1 MeV at θ(c.m.) = 169°, from 2.05 to 2.7 MeV at θ(c.m.) = 100°, and from 1.3 to 2.35 MeV at θ(c.m.) = 90°. Angular distributions were taken at E_{He^3} (lab.) = 1.941 and 2.373 MeV. The $O^{16}(He^3,\alpha)O^{15}$ differential cross section was measured at θ(lab.) = 90° in the region of a broad (300 keV) resonance near E_{He^3} = 2.36 MeV. The assignment of $J = \frac{1}{2}^+$ was made to this level. The back angle elastic cross section starts to rise at E_{He^3} = 2.9 MeV, indicating the start of another resonance.

The $O^{16}(\alpha,\alpha)O^{16}$ differential cross section was measured from 0.6 to 1.71 MeV with a 4 keV target and 2 keV steps. No resonances were observed. However, preliminary attempts to observe $O^{16}(\alpha,\gamma)Ne^{20}$ capture γ rays indicate the possibility of a resonance for E_α between 1.1 and 1.6 MeV.

Microfilm $2.75; Xerox $6.40. 132 pages.

CROSS SECTION FOR DISSOCIATIVE RECOMBINATION OF NITRIC OXIDE

(Order No. Mic 61-2402)

Burton Elliott Squires, Jr., Ph.D.
The Pennsylvania State University, 1961

An attempt is made to set up a model for the calculation of the cross section for dissociative recombination of NO^+, namely the reaction $NO^+ + e^- \rightarrow N + O$. In this reaction it is assumed that a nitric oxide molecular ion in its ground state ($^1\Sigma^+$) captures a free electron of low energy and splits up into two neutral atoms in the state $N(^2D) + O(^3P)$. The calculation of such cross sections is of particular interest in considerations involving the D-region of the ionosphere. The reaction is broken up by assuming the existence of an intermediate state NO* which invariably decays into N and O. Time-dependent first order perturbation theory is then used to calculate the cross section for the reaction $NO^+ + e^- \rightarrow NO^*$. The method follows to a large extent the outline suggested by Bauer and Wu,[1] but differs from this work in several important particulars. This previous work is discussed and criticized. Using quite rough approximations the cross section for 1 ev. electrons is estimated to be of the order of 10^{-15} cm^2.

1. Ernest Bauer and Ta-You Wu, "Cross Sections of Dissociative Recombination," Canadian Journal of Physics 34, 1436 (1956).

Microfilm $2.75; Xerox $4.40. 83 pages.

ENERGY LOSS MECHANISMS FROM VERY DENSE STARS

(Order No. Mic 61-1431)

Robert Coleman Stabler, Ph.D.
Cornell University, 1960

It has long been speculated that after a star exhausts its nuclear energy sources it may contract to very high densities in the form of a neutron star. Recently Salpeter[1] and Cameron[2] have investigated, respectively, the theoretical and astrophysical aspects of such nuclear matter at zero temperature. At non-zero temperature energy losses occur through the emission of neutrinos and radiation. Both processes are investigated here.

Expressions for the energy loss in the urca process (electron capture followed by beta decay) of Gamow and Schoenberg[3] are obtained for the case of degenerate electrons, and for both degenerate and non-degenerate nuclei, as a function of the rearrangement energy Q, the temperature, and the Fermi energy E_F. It is found, for instance, for E_F = 25 Mev, Q = 24 Mev, and for allowed transitions, that the urca process can yield energy losses as high as 10^5 ergs/gm-sec at T = 10^9 °K. The losses are critically damped for T much less than E_F - Q.

A field theoretic calculation of the cross section for the production of neutrino—anti-neutrino pairs in the scattering of radiation from electrons is performed. The resulting energy loss at 10^9 °K ranges from 10 ergs/gm-sec for E_F = 25 Mev to 10^6 ergs/gm-sec for non-degenerate electrons, increasing monatonically with decreasing density. In general we have the energy loss equal to $8 \times 10^6 (Z/A) T_9^8$ ergs/gm-sec where $T_9 = T/10^9$ °K, in the non-degenerate, non-relativistic limit, and equal to $4 \times 10^5 (Z/A)\, T_9^7 (1 + 5T_9^2) \times (m/E_F)^3$ in the degenerate and relativistic limit.

A comparison is made between this process and the Pontecorvo process (emission of neutrino pairs in electron scattering from ions) for the non-relativistic and non-degenerate case. It is found that "Thomson scattering" produces larger energy losses at low densities (10^6 gms/cc) and high temperatures (2×10^8 °K). It is not clear which neutrino emission mechanism yields the largest energy loss at very high densities due to the uncertainties in the urca and Pontecorvo processes. However, the lower limit of neutrino energy loss is given by the Thomson scattering formulae obtained here and is large.

Concerning the radiative luminosity it is found that electron conduction will predominate over radiative and neutron conduction at high densities. By solving the stellar equilibrium equations the luminosities of very dense stars ($\rho_c \gtrsim 10^{12}$ gms/cc) are given as a function of central temperature and density. Approximate cooling times, ranging from a month to 10^5 years depending critically on the central temperature, are also given. It is found that for $T \gtrsim 5 \times 10^8$ °K the star will be neutrino cooled with a rate proportional to T^4. For $T \lesssim 5 \times 10^8$ radiation will cool the star with a rate proportional to $T^{3/2}$.

1. E. E. Salpeter, to be published in Annals of Physics.
2. A. G. W. Cameron, Astrophys. J. 130, 884 (1959).
3. G. Gamow and M. Schoenberg, Phys. Rev. 59, 539 (1941).

Microfilm $2.75; Xerox $3.80. 70 pages.

PHOTOPRODUCTION OF SINGLE NEUTRAL PIONS AT FORWARD ANGLES FROM HYDROGEN IN THE REGION FROM 700 TO 1200 MEV

(Order No. Mic 61-2451)

James Arthur Waggoner, Ph.D.
Cornell University, 1961

The bremsstrahlung beam of the Cornell Bev electron synchrotron has been used to study the reaction $\gamma + p \rightarrow p + \pi^\circ$ over the photon energy range 700 to 1200 Mev, for center of mass pion angles between 24° and 32°. The recoil protons were detected by nine thin plastic scintillators enclosed in a vacuum chamber with the liquid hydrogen target. The photon energy was determined by the photon difference method in 100 Mev intervals. The information from the scintillators was obtained by photographing an oscilloscope display and was used to identify the protons. The results agree well with previous experiments and support a $F_{5/2}$ assignment for the 1050 Mev resonance level in the pion-nucleon system.

Microfilm $2.75; Xerox $4.60. 89 pages.

ELECTROMAGNETIC PRODUCTION OF PION PAIRS

(Order No. Mic 61-1484)

Clayton D. Zerby, Ph.D.
The University of Tennessee, 1960

Major Professor: R. D. Present

The suggestion that the electromagnetic production of pion pairs may be a possible way of investigating the $\pi - \pi$ interaction has stimulated this study of the Pauli-Weisskopf theory of pair production in the experimentally attainable region just above threshold. The Pauli-Weisskopf theory was investigated with the objective of including the strong pion-nucleus interaction in the form of a complex optical potential as a means of determining the increase in the cross section resulting from this interaction. It was found that the potentials could be included in the field equations in a consistent manner that would lead to the absorption and scattering of the pions after production if the real part of the potential was a world scalar and the imaginary part was the time component of a four-vector. The matrix element for pair production was obtained by using exact waves which were expanded into angular momentum states, and numerical calculations were performed to examine the effect of a nuclear charge distribution and nuclear potential on the cross section. In the region just above threshold it was found that the cross section for lead with a charge distribution of the form obtained from electron scattering experiments was approximately a factor 10^{-4} smaller than that obtained with a point charge nucleus and that this reduction in the cross section was regained when a nuclear optical potential was included that had a depth consistent with pion scattering experiments. The calculations show that the cross section for lead with a charge distribution and nuclear optical potential increases slowly just above threshold until approximately 295 Mev, where

it starts to increase almost linearly, attaining a value of 1.07×10^{-32} cm^2 at 310 Mev.

Microfilm $2.75; Xerox $5.60. 111 pages.

AN APPARATUS FOR MEASURING FAST NEUTRON POLARIZATION AND A MEASUREMENT OF D(d,n)He^3 NEUTRON POLARIZATION

(Order No. Mic 61-1560)

Martin Samuel Zucker, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Henry H. Barschall

An instrument for measuring fast neutron polarization has been developed. The instrument combines three main virtues: the ease with which angular distributions of polarization can be measured, the extent to which extraneous nuclear events can be eliminated, and the unequivocal manner in which the counter can be checked for false asymmetries.

The instrument was used to measure the angular distribution of polarization of neutrons from the D(d,n)He^3 reaction in the neighborhood of 2-3 Mev deuteron bombarding energy. These angular distributions showed marked departure from the accepted theory for this reaction. A decrease of the maximum of the polarization (as a function of angle) with increasing bombarding energy was found, in accordance with a theoretical prediction.

Microfilm $2.75; Xerox $4.00. 75 pages.

PHYSICS, SOLID STATE

A STUDY OF THE AGING PHENOMENON IN BARIUM TITANATE SINGLE CRYSTALS

(Order No. Mic 61-2173)

Paul David Baba, Ph.D.
Rutgers University, 1961

Major Professor: Professor John H. Koenig

Using the double crystal diffractometer, the strain conditions in barium titanate single crystals were studied while the crystals were allowed to age. From the results, a correlation between aging and strain conditions was found along with a progressive change in the domain orientation. This change was also observed under the polarizing microscope and was found to be more pronounced when a metal electrode was applied to the sample. A theory involving the surface space charge layer in barium titanate was proposed and was tested by means of a thickness dependence experiment. Effect of defluorination of the crystals was investigated.

Microfilm $2.75; Xerox $6.60. 140 pages.

THE STRUCTURAL AND TRANSPORT PROPERTIES OF THE PSEUDO-BINARY ALLOY GeTe-SnTe

(Order No. Mic 61-1506)

James Nieman Bierly, Jr., Ph.D.
Temple University, 1961

Measurements of the room temperature lattice constants of the pseudo-binary alloy GeTe-SnTe show a continuous transformation from a face-centered rhombohedral lattice at GeTe, to a NaCl type lattice, starting at 30% GeTe - 70% SnTe and continuing to SnTe. Determinations of the structure above and below room temperature reveal a continuous variation in structure as a function of temperature. GeTe is rhombohedral at room temperature and gradually transforms to a NaCl type structure, T_c = 425°C. As the percentage of SnTe is increased in the alloy system, the temperature at which the rhombohedral system transforms to a NaCl type structure is decreased, and beyond 70% SnTe the transformation occurs below room temperature. SnTe retains a NaCl type structure, at least to 77°K. Metallographic examination of the alloys reveals a banded structure in alloys which were rhombohedral at room temperature. These bands are interpreted as being twin bands and are thought to arise from the strain at the cubic-rhombohedral interface.

The resistivities, Seebeck and coefficients and Hall constants were measured from 100°K to 450°K, and the thermal conductivity was measured at 300°K. The resistivity versus temperature curves all had positive temperature coefficients, which together with a carrier concentration of about 6×10^{20} positive carriers per cc, indicated that all of the alloys in the series were semi-metals. The Seebeck coefficients were linear and positive in the measured temperature range. Room temperature values of the resistivity, Hall constant and Seebeck coefficient were of the order of $\rho = 10^{-4}$ ohm-cm, $R = 10^{-2}$ cm^3/coulomb, $S = 30$ μv/deg respectively. The Hall constant increased with temperatures for alloys on the tin rich end of the system, and decreased at elevated temperatures for germanium rich alloys. This behavior was interpreted using a two band model with overlapping conduction and valence bands.

The total thermal conductivity at room temperature was approximately 0.07 w/cm-deg for GeTe and SnTe and 0.035 w/cm-deg for the 50-50 alloys. The lattice contribution to the thermal conductivity derived using the Wiedemann-Franz Law and the room temperature values of the resistivity was small, indicating that the thermal conductivity was primarily electronic.

It was observed that the temperature dependent curves of S, K and ρ all showed variations from a smooth curve in the range of temperatures where the lattice was undergoing a transition from rhombohedral to cubic. This variation was interpreted as an indication of the effects of lattice shear strains on the transport properties. The lattice distortions producing the shear strains were assumed to be the result of different size ionic radii for the components of the alloys.

Both the structural and transport properties of GeTe-SnTe, show a marked resemblance to the elements of the group Vb elements As, Sb and Bi.

Microfilm $2.75; Xerox $6.20. 126 pages.

THE HEAT CAPACITY OF SEVERAL SUPERCONDUCTORS AND OTHER SOLIDS AT VERY LOW TEMPERATURES

(Order No. Mic 61-2464)

Cyrus Anthony Bryant, Jr., Ph.D.
Purdue University, 1961

Major Professor: P. H. Keesom

The heat capacities of rhenium, indium, and tin have been measured between 1/3 and 4 1/2 °K in the normal and superconducting states. Motivation was chiefly to determine the temperature dependence of the superconducting electronic specific heat C_{es} as far down as possible, comparing the result with the theory that it should have the form $A\gamma T_c \exp(-bT_c/T)$, where γT is the normal electronic term and T_c, the transition temperature. Assuming the normal and superconducting lattice terms to be equal and of the form $\alpha T^3 + \beta T^5 + \mu T^7$, C_{es} was considered to be the superconducting specific heat minus the normal lattice term. However, in the case of rhenium there was found an anomalous contribution $A_o T^{-2}$ due to the nuclear electric quadrupole moment of the Re interacting with the crystalline field. The constant parameters in the specific heat were: $\gamma = 2.31 \pm .04$ millijoule/mole deg.^{2}, $\alpha = 0.027 \pm .004$ millijoule/mole deg.^{4} (corresponding to a Debye temperature $\theta = 417 \pm 20$ °K), $A_o = 0.052$ millijoule deg/mole (corresponding to RF resonance frequencies of 42 and 84 Mc) 1.70 °K (the transition was quite broad, continuing until 1.83 °K).

The salient feature in the results on indium was a superconducting specific heat less than the normal lattice term below 0.8 °K, around 30% less at 0.37 °K. This conflicts with the assumption of equal normal and superconducting lattice terms unless there exists a negative contribution in the superconducting state. Accounting for a small nuclear quadrupole specific heat, $9 \times 10^{-4} T^{-2}$ millijoule/mole deg., it was found that (for one sample) the normal specific heat C_n could be represented as $(1.59 \pm .02)T + (1.53 \pm .03) T^3 + 0.008 T^5 + (9 \times 10^{-4}) T^{-2}$ millijoule/mole deg., $0.35 < T < 4.5$ °K. The Debye temperature corresponding to the T^3 part of the lattice term is $\theta = 108$ °K. With the choice of a = 11 and b = 1.6 in the expression for C_{es}, the superconducting specific heat became expressible as $59.5 \exp(-1.6\, T_c/T) + 1.72 \exp(-0.051\, T_c/T)\, T^3 + (9 \times 10^{-4})\, T^{-2}$ millijoule/mole deg., $T < 0.7\, T_c$. The first term is C_{es}; the third, the nuclear quadrupole term; and the second, everything left over, expressed as a modified T^3 lattice term. In contrast, the specific heat of tin could be represented in the usual way, with equal normal and superconducting lattice terms: $C_n = \gamma T + \alpha T^3 + \beta T^5 + \mu T^7$ and $C_s = a\gamma T_c \exp(-bT_c/T) + \alpha T^3 + \beta T^5 + \mu T^7$, with $\gamma = 1.80 \pm .02$, $\alpha = 2.42 \pm .04$ ($\theta = 200$ °K), $\beta = 0.0040$, $\mu = 0.00014$, a = 7.63 and b = 1.41; all of these are in millijoule units. Magnetic measurements give $T_c = 3.714$ °K, but the specific heat discontinuity appeared at 3.701 °K; the difference has not been satisfactorily explained. Thermodynamic calculations of the critical magnetic field at 0 °K, H_o, yielded 284 oe. for In and 306 oe. for Sn. In the case of tin, critical field $H_c(T)$ was less than $H_o[1 - (T/T_c)^2]$ for all $T < T_c$, as found in most superconductors; but for indium the deviation of $H_c(T)$ from this parabolic form was negative only down to 0.8 °K, and positive below this temperature.

Measurements above 1 °K of two molybdenum specimens (nonsuperconducting) resulted in $\gamma = 1.91$ and $1.93 \pm .02$ millijoule/mole deg., and $\theta = 458 \pm 15$ °K. Results on superconducting Mo-Rh alloys are reported, but remain inconclusive because of the difficulty of determining the concentration of Rh and the nonuniform composition.

The contribution by 0.09% manganese to the specific heat of silver did not reveal the expected maximum in C/T above 0.35 °K, the lowest temperature measured. Although a Schottky type specific heat is expected from reorientation of the electron spins on the Mn ions in some local magnetic field, the high temperature tail of the specific heat contribution does not have a T^{-2} dependence below 3 °K. This was interpreted to mean either that the local magnetic field at the Mn ions must be the order of 10^3 oe., which is unbelievably large, or that some other cooperative effect exists among the Mn ions which produces a contribution in addition to the Schottky term.

The specific heat of pure germanium could be specified below 4°K by $\alpha = 0.0380 \pm .0005$ millijoule/mole deg.^{4}, corresponding to $\theta = 371 \pm 2$ °K. The electronic specific heat, T and θ were also reported for several samples of degenerate N type germanium. It was found that as impurities were added, θ decreased to as low as 363 °K for $0.47 \times 10^{+19}$ cm^{-3} arsenic in the sample. As expected, γ increased as the conduction band filled with electrons, allowing the calculation of effective mass and Fermi energy on the basis of the oversimplifying assumption of a parabolic-shaped conduction band, neglecting the influence of the impurity band on the distribution of energy states. Microfilm $2.75; Xerox $5.80. 119 pages.

EFFECT OF PRESSURE ON THE ETTINGSHAUSEN-NERNST EFFECT IN ZINC AT HELIUM TEMPERATURES

(Order No. Mic 61-2118)

Ronald Joseph Deck, Ph.D.
Louisiana State University, 1961

Supervisor: Professor Joseph M. Reynolds

A piston and cylinder combination using solid hydrogen as a pressure transmitting medium was constructed for the purpose of studying pressure dependence of the Ettingshausen-Nernst effect in zinc. The apparatus was designed to produce a maximum of 5,000 atmospheres of hydrostatic pressure at helium temperatures in a .25 inch diameter cylinder.

The technique involved was that originally pioneered by Stewart and Swenson. The piston and cylinder were made of beryllium-copper and were lap fitted and polished. A seal was effected between the surfaces of the piston and cylinder by means of a potassium ring which supported the force applied to the piston. Hydrogen was condensed into the cylinder during the process of bringing the apparatus down to liquid helium temperatures. Ten electrical leads entered the pressure chamber through an epoxy resin seal and were used to make the desired measurements.

The Ettingshausen-Nernst potential was recorded as a function of magnetic field at different pressures, while pressure was being increased in steps, and also while

pressure was being decreased in steps. In the case of increasing pressures the oscillations in Ettingshausen-Nernst potential exhibited diminished amplitude and a phase shift before and after which the periods differed. For decreasing pressures a larger amplitude and no phase shift were observed. The explanation was assumed to lie in the fact that the ortho-para conversion in solid hydrogen, which absorbs heat in the case of increasing pressures and releases heat in the case of decreasing pressures, gave rise to the phenomenon of a larger heat current in the crystal for decreasing pressures than for increasing pressures, and a transverse component of heat current for increasing pressures giving rise to a thermoelectric effect superimposed upon the Ettingshausen-Nernst potential. No attempt was made to separate out the Ettingshausen-Nernst potential in the case of increasing pressures because of the uncertainty in the magnitude of the heat current involved and only measurements taken at decreasing pressures truly represent the Ettingshausen-Nernst potential. The period of the oscillations was found to decrease with pressure almost linearly from 0 to 1450 atmospheres.

The period of a de Haas-van Alphen type oscillation is inversely proportional to the area of the projection of the segment of Fermi surface giving rise to the oscillation onto a plane perpendicular to the magnetic field direction. Harrison has used a single orthogonalized plane wave approximation to determine this area for zinc when the field is parallel to the hexagonal axis. Very poor agreement is achieved in attempting to use this to predict the behavior of period versus pressure. Some calculations were made which determine this area in terms of Fourier coefficients occurring in an expansion of the periodic potential. The behavior of these coefficients with pressure is not predicted by the calculations, but assuming that they are uneffected by pressure one gets fair agreement with the data. Microfilm $2.75; Xerox $3.80. 69 pages.

D.C. EFFECTS IN FERROMAGNETIC RESONANCE OF THIN NICKEL FILMS

(Order No. Mic 60-4310)

Walter G. Egan, Ph.D.
Polytechnic Institute of Brooklyn, 1961

Adviser: Hellmut J. Juretschke

Ferromagnetic resonance has been observed in nickel films thin compared to their skin depth by the appearance of d.c. electric fields in the film plane. These d.c. voltages have been attributed primarily to the Hall effect interaction of the microwave electric and magnetic fields by virtue of the precession of the magnetization. This thesis deals with the design and execution of a series of experiments to test fully a detailed theory following this assumption proposed by Juretschke. Pulsed microwave energy at a frequency of 10 KMC and peak powers of 5.6 KW impinges upon a nickel film located transversely in a waveguide in front of a short of adjustable spacing and the observed voltage in the film plane is measured as a function of film location, incident microwave power, direction and magnitude of a static magnetic field. With respect to the latter, the voltage displays a pronounced peaking near the condition for ferromagnetic resonance. As predicted by the theory, the signal is composed of two contributions, one due to the Hall effect, the other due to the ferromagnetic magnetoresistive anisotropy. All detailed features of the theory have been verified, in an experimental arrangement in which greatest care was taken to subject the film to controlled and known local electromagnetic fields, since the microwave boundary conditions at the film can critically influence the observed effects. The theoretical interpretation of the results permits determining electrical film parameters such as surface resistivity, extraordinary Hall coefficient and anisotropic magnetoresistivity of thin films at microwave frequencies, in addition to their magnetic parameters such as saturation magnetization, relaxation time, g-value. For the latter, the method has the advantage over conventional resonance experiments for thin films of being more sensitive (the signal is largest for the thinnest films) and of requiring less elaborate equipment. Four typical films investigated in detail by this method give values of surface resistivity and extraordinary Hall coefficient larger than at d.c., while the anisotropic resistivity remains unchanged. Analysis of the magnetic properties reveals lower saturation magnetizations but about the same relaxation time and g-values as in bulk nickel. Most of the deviations observed are in the direction to be expected for thin films.

Microfilm $2.75; Xerox $4.60. 88 pages.

THERMOELECTRIC AND OPTICAL PROPERTIES OF CALCIUM OXIDE

(Order No. Mic 61-2280)

Homer Hopson Glascock Jr., Ph.D.
University of Missouri, 1961

Supervisor: E. B. Hensley

The specific electrical conductivity and thermoelectric power of sprayed aggregates of calcium oxide were measured, as a function of temperature, for several states of activation and were found to exhibit the characteristics of a pore conductor. The typical break in the conductivity curve occurred at about 900°K in well activated samples. From this temperature, and an estimate of the mobility of an electron in calcium oxide, the electron affinity of calcium oxide is estimated to be .7 ev.

The opacities of thin backed films of calcium oxide were measured at room temperature over the energy range 5.5 to 11.3 ev. At energies below 6 ev the opacity was low. A sharp peak, attributed to the formation of excitons, was observed at about 7.1 ev. Two other strong maxima occurred near 8.3 and 10.0 ev. Maxima may also exist around 9.3 and 11.0 ev. The width of the forbidden band of calcium oxide is estimated to be near 7.7 ev.

Microfilm $2.75; Xerox $5.00. 97 pages.

HIGH DENSITY EXPANSION FOR THE ISING MODEL WITH ARBITRARY SPIN AND RANGE OF INTERACTION

(Order No. Mic 61-2039)

Gerald Horwitz, Ph.D.
University of Pennsylvania, 1961

Supervisor: Herbert B. Callen

A diagrammatic expansion is given for the free energy of a three-dimensional Ising model of arbitrary spin and range of interaction. By appropriate renormalization of the vertices of the diagrams this expansion is restricted to linked irreducible diagrams (i.e. diagrams having no articulation points). By a modification of a criterion introduced by R. Brout, the renormalized rather than the original unrenormalized diagrams are classified in powers of 1/z (z measuring the number of ions within the effective range of interaction of any given ion). The free energy is computed to first order in 1/z. For the special cases of simple cubic, body-centered cubic and face-centered cubic lattices with nearest neighbor interactions, and spin 1/z, the Curie temperature is evaluated numerically. To first order in 1/z for these cases, the specific heat is continuous with an infinite slope on the low temperature side and a finite slope on the high temperature side; these quantitative results are in close agreement with the spherical model. Microfilm $2.75; Xerox $5.60. 113 pages.

INTERNAL FRICTION IN ALUMINUM OXIDE SINGLE CRYSTALS

(Order No. Mic 61-1132)

Robert John Huber, Ph.D.
University of Utah, 1961

Chairman: George S. Baker

Internal friction measurements have been made on aluminum oxide single crystals in longitudinal oscillation at a frequency of 50 kilocycles per second and at strain amplitudes up to 10^{-5}. Measurements were made by the composite oscillator technique as a function of temperature between 25°C and 1850°C, and as a function of plastic deformation of the samples. The samples, in the form of 0.1 inch diameter rods several inches long, were deformed in tension along the axis of the rod. Maximum strains correspond to an approximate 20% increase in length of the rod. Dislocation densities range from about 5×10^6 dislocations/cm.^{2} in the undeformed crystals to near 5×10^7 dislocations/cm.^{2} in the heavily deformed samples. Undeformed crystals showed no observable change in internal friction below 1800°C. Samples deformed near 1300°C showed a thermally activated change in internal friction which was observable above a background logarithmic decrement of 4×10^{-5} at temperatures greater than 1450°C. The logarithmic decrement at the maximum temperature of 1850° was 4×10^{-3}. Activation energies ranged between 80 and 140 kilocalories/mole. A few minutes exposure of these samples to temperatures above 1900°C resulted in a decrease of a factor of 5 in the internal friction vs. temperature curve. Crystals deformed in tension in an oxygen-natural gas flame near 1900°C showed a similar in form, but smaller increase in internal friction than the samples deformed at the lower temperature. No amplitude dependence was observed at strains of 10^{-5} or less.

The internal friction changes observed are attributed to moving dislocations. It is shown that mechanisms in which the dislocation motion is due to climb or to thermally activated motion over Peierls' barriers are improbable. A model in which the energy losses are caused by stress induced increases in the width of extended dislocations is discussed and shown to be invalid in this case. It is suggested that the internal friction is caused by motion of tightly pinned dislocations in the slip plane by a process in which relatively short segments, less than about 50 lattice distances long, move at most a few Burger's vector lengths in independent events.

Microfilm $2.75; Xerox $4.40. 85 pages.

GALVANOMAGNETIC PROPERTIES OF CARRIERS ASSOCIATED WITH THE CLEANED GERMANIUM SURFACE

(Order No. Mic 61-1647)

Rolland Albert Missman, Jr., Ph.D.
University of Illinois, 1961

The galvanometric properties of the carriers associated with the clean germanium surface have been measured. The carriers associated with the (100) surface have a p-type Hall contribution from 90°K to 300°K. The mobility of these carriers ranges between 500 cm^2/volt-sec and 1200 cm^2/volt-sec and for a given specimen is constant over this temperature range. The number of these carriers is about 10^{12} per square centimeter and is essentially constant with temperature indicating that they are degenerate. There is no evidence for the presence of n-type carriers but their presence cannot be definitely ruled out. If they are present on the (100) surface their mobility is much smaller than that of the holes.

A qualitative picture of the energy band situation at the clean surface results from these measurements. The energy bands appear to be bent upward such that the valence band crosses the Fermi level at the surface. The bending is caused by the presence of relatively immobile electrons distributed randomly over the surface with a density of one per one thousand surface atoms. The same number of holes moves near the surface in the Coulomb fields of these electrons and gives most of the surface conductance.

One specimen having a (111) surface was measured and the results showed that there may be both positive and negative carriers with high mobilities present at the surface. Microfilm $2.75; Xerox $4.20. 76 pages.

DEUTERON JUMPING IN KD_2PO_4

(Order No. Mic 61-2104)

Victor Hugo Schmidt, Ph.D.
University of Washington, 1961

Chairman: Edwin A. Uehling

Magnetic resonance studies of the deuteron in KD_2PO_4 have been conducted which show the existence of deuteron jumping between and within hydrogen bonds. The experimental results help to explain electrical conductivity and ferroelectric phenomena in crystals of this type.

Pulse magnetic resonance experiments show the lifetime T_{xy} against deuteron jumping between X and Y-oriented hydrogen bonds to be 15 milliseconds at 70°C, with an activation energy of approximately 0.582 ev. The c-axis electrical conductivity of KD_2PO_4 is found to have the same activation energy, with a value of 1.16×10^{-10} $(ohm\text{-}cm)^{-1}$ at 25°C. The conductivity and T_{xy} results are explained in terms of creation, motion and recombination of excess and vacancy deuterons. Although attempts to measure the mobilities of these carriers by means of Hall effect and other experiments were unsuccessful, interesting phenomena were noted in the course of these experiments.

The $\Delta m = 1\,(P_1)$ and $\Delta m = 2\,(P_2)$ deuteron spin-lattice relaxation transition probabilities due to deuteron jumps between bonds, calculated from T_{xy} and the known electric field gradient (efg) tensor at X and Y-bond deuteron sites,[1] are proportional to $H_o^{-2}\exp(-0.582\ ev/kT)$ and have strong orientational dependence. The calculated magnitudes of P_1 and P_2 and their magnetic field, temperature and orientation dependences are found to be in good agreement with experiment.

Measurements of $P_1 + 2P_2$ over a wide temperature range show the existence of a component of transition probability proportional to $H_o^{0}\exp(+0.078\ ev/kT)$. Measurements made by an original method of P_1 and of P_2 separately at several crystal orientations show this component of relaxation to be caused by deuteron jumps along bonds, when the special nature imposed by the crystal symmetry of the change in efg tensor from one side of the bond to the other is taken into account. This intrabond jump time is of order 10^{-11} seconds at 215°K. The existence of intrabond jumps governed by an activation energy is shown to be consistent with the Slater[2] theory of KH_2PO_4 as modified by Takagi.[3]

Below the ferroelectric Curie temperature, P_1 and P_2 due to jumps within bonds become negligible, and only a small component of transition probability consistent with spin diffusion to paramagnetic impurities remains.

1. J. L. Bjorkstam and E. A. Uehling, Phys. Rev. 114, 961 (1959)
2. J. C. Slater, J. Chem. Phys. 9, 16 (1941)
3. Y. Takagi, J. Phys. Soc. Japan 3, 271, 273 (1948)

Microfilm $2.75; Xerox $6.60. 138 pages.

BOMBARDMENT OF TUNGSTEN WITH 20 KEV HELIUM ATOMS IN A FIELD ION MICROSCOPE

(Order No. Mic 61-2401)

Mahendra Kumar Sinha, Ph.D.
The Pennsylvania State University, 1961

Almost all work in radiation damage has been based on the study of changes in the bulk properties of solids as a result of irradiation. These changes have been explained as a result of the production of vacancies, interstitial atoms and thermal or displacement spikes.

With the invention of the field ion microscope, it became possible to observe directly the atomic defects in metals. In the present work, the bombardment of tungsten tips at 21°K by 20 kev helium atoms has been studied with a low temperature field ion microscope. The 20 kev He atoms were obtained by charge changing of helium ions accelerated from a Penning discharge.

The defects found are vacancies, interstitials and their clusters, and a disordering of atoms in a region of about 50 – 100 A diameter. This region may be the intersection of a thermal spike by the surface of the tip.

The number of neutral atoms hitting the tip per second ranged from one to 33. The number of displaced atoms appearing on the surface or one atomic layer deep have been counted and the total number of displaced atoms in the volume of the tip have been calculated from the hard sphere approximation. Surprisingly a large fraction of the calculated number of displaced atoms appear on the surface. This is supposed to be the result of the high electric field of about 450 MV/cm at the surface of the tips, when it is bombarded and observed. Further, the surface itself acts as a sink for the defects.

Tips of different radii (200 A – 900 A) have been bombarded, and the ratio of the damage on the entrance side of the beam and the exit side increases with increasing radius.

The migration of interstitials or their clusters to the surface was studied by raising the temperature of the tip up to 110°K, and also at liquid hydrogen temperature. The interstitials can move at 21°K and a rapid migration occurs in the region 90° – 100°K.

The tips were also bombarded by much heavier atoms of mercury. The damage is very different. Vacancies and interstitials are produced but the number of regions in which disordering of atoms occurs are more than that with helium bombardment. Additionally, field evaporation of some atomic planes takes place. This is explained as a result of field reduction of the energy barrier for the atoms to leave the surface.

All the above experiments were done with the high field at the tip in order to keep it clean. This produces a high outward stress of about 10^{10} dynes/cm^2 which causes some of the defects to disappear from the surface and to bring out others from inside. This is confirmed by bombarding experiments with the field off.

Microfilm $2.75; Xerox $3.00. 59 pages.

EXPERIMENTAL DETERMINATION OF THE THERMAL CONDUCTIVITY AND PELTIER TENSORS IN A SINGLE CRYSTAL OF ZINC AT LIQUID HELIUM TEMPERATURE

(Order No. Mic 61-2133)

Nadim Hanna Zebouni, Ph.D.
Louisiana State University, 1961

Supervisor: J. M. Reynolds

The variation of the thermal resistance, Righi-Leduc, Peltier and Ettingshausen effects, at liquid helium temperatures, in magnetic fields up to 10 kilogauss has been investigated. The measurements were taken with either a constant heat current or a constant electric current flowing perpendicular to the hexagonal axis. The magnetic field was parallel to the hexagonal axis.

The magnetoresistance, Hall effect, thermoelectric power and Ettingshausen-Nernst effect were measured in the same crystal, in the same conditions.

The Righi-Leduc effect is found to change sign at 5400 gauss. Oscillations of de Haas-van Alphen type were found, with a period $P = 6.14 \times 10^{-5}$ gauss^{-1}. The Ettingshausen effect is found to be purely oscillatory with $P = 6.45 \times 10^{-5}$ gauss^{-1}. The amplitude of the oscillations seem to increase linearly with the magnetic field strength. The Peltier effect shows oscillations with $P = 6.28 \times 10^{-5}$ gauss^{-1}, superimposed on a strong linear monotonic increase whose slope is -3.24 deg-cm/amp/Kgauss. A phase inversion of the oscillations is observed for $H < 5$ Kgauss, similar to what has been already observed in the thermoelectric power oscillations.

From the comparison of the Hall and Righi-Leduc effects, an apparent transverse Lorenz ratio is computed. Similarly, from comparison of the thermal and electrical magnetoresistance effects an apparent longitudinal Lorenz ratio is computed. Their behavior is compared with theory and with previous results found in the literature.

An extrapolation gives an estimate of the lattice conductivity of zinc at 2°K, equal to .02 watt/deg-cm.

The thermoelectric power and Ettingshausen-Nernst results are compared respectively with the Peltier and Ettingshausen results in the light of the Onsager Theorem. An excellent agreement with the theory is found.

The two thermoelectric coefficients ϵ''_{11} and ϵ''_{21}, defined by the equation,

$$J_i = \sigma_{ik} E_k^* - \epsilon''_{ik} G_k \qquad i,k = 1,2,$$

are computed and their behavior analyzed in the light of recent theories.

Microfilm $2.75; Xerox $5.00. 96 pages.

PHYSIOLOGY

THE INFLUENCE OF AMBIENT TEMPERATURE ON EARLY PREGNANCY LOSS AS DETERMINED BY EMBRYO TRANSFER

(Order No. Mic 61-2289)

Charles Walter Alliston, Ph.D.
North Carolina State College, 1960

Supervisor: Lester Curtis Ulberg

Effects of ambient temperature upon early embryo development were studied by means of embryo transfers in sheep. Estrus was synchronized in donor and recipient ewes to within 24 hours either naturally or with the aid of hormones. Five days before predicted estrus ewes were placed in environmental chambers maintained at 70 or 90°F, 65 per cent relative humidity. Donors were bred on the subsequent estrus to rams producing high quality semen. Embryo transfers were performed 72 to 84 hours later. Transfers were considered successful when an embryo continued development to 30 days post-mating.

Where both the donor and recipient were maintained at 70°F, 13 of 23 (56.5%) between animal transfers were successful as compared with 6 of 25 (24.0%) where donor and recipient ewes were maintained at 70 and 90°F, respectively. Only two of twenty-one (9.5%) were successful where donor and recipients were held at temperatures of 90 and 70°F, respectively.

To evaluate possible harmful effects of transfer, embryos were either not transferred or were placed in the original donor when multiple ovulations occurred. Five of seven (71.4%) and none of four untransferred embryos continued development in 70 and 90°F groups, respectively, assuming one embryo was produced per corpus luteum. Six of eight (75.0%) within animal transfers were successful in the 70°F group, but no pregnancies resulted from two transfers in the 90°F group.

To further verify the harmful effect of high ambient temperature, 76 purebred Dorset and Hampshire ewes were subjected to the above or prevailing atmospheric temperatures for 18 days after mating. Allocation to treatment was made within 12 hours of onset of estrus and no transfers were performed in these groups. In the 70°F, 90°F, and atmospheric temperature groups, 37, 33, and 0.0 per cent, respectively, of the ewes lambed from first service.

Body temperature and respiration rates were positively correlated with ambient temperature.

To test the feasibility of using exogenous hormones to synchronize estrus, 48 additional ewes were utilized to evaluate the progesterone and pregnant mare serum (PMS) by the number of lambs born. In the hormone treated group, 22 lambs were born to 15 ewes as compared with 20 born to 17 ewes in the control group.

The following conclusions can be made: (1) A temperature of 90°F does impose a "physiological stress" on ewes as measured by body temperature and respiration rate. (2) The reproductive performance of sheep is lowered by exposure to an ambient temperature of 90°F as compared with 70°F, which is partially due to a lower

fertilization rate and partially to an increase in embryonic mortality. (3) Between onset of estrus and three days after mating, the embryo is adversely affected by exposure of the ewe to the higher temperature to the extent that the damage is not alleviated by transferring the embryo to a uterus capable of supporting growth. (4) A technique of embryo transfer can be used without significantly increasing embryonic death. There are indications, however, that some antagonism exists between the uterus of one animal and the embryo of another. (5) Onset of estrus in donor and recipient should be synchronized to within 24 hours. This can be accomplished through a system of controlled ovarian activity with progesterone and PMS injections without lowering reproductive performance. (6) A degree of refractoriness to PMS was indicated by a decrease in ovulation rate with each successive injection within a breeding season. This effect was not present between different breeding seasons.

Microfilm $2.75; Xerox $3.60. 64 pages.

INVESTIGATIONS ASSOCIATED WITH THE TRANSPLANTATION OF BOVINE OVA

(Order No. Mic 61-2134)

Thomas Lee Avery, Ph.D.
University of Minnesota, 1961

Problems associated with the transplantation of bovine ova were investigated with certain areas receiving major emphasis.

Estrus synchronization was studied from the standpoints of methods of accomplishment and subsequent effects on conception. Recycling was accomplished by: (a) daily subcutaneous injections of progesterone, (b) larger subcutaneous injections every third day, (c) corpus luteum expression. Standing estrus was exhibited by 262 cows. Twelve did not exhibit estrus and 54 others exhibited symptoms but refused mounting. Times post-treatment to estrus were 4.97 ± 1.82, 6.52 ± 1.25 and 2.84 ± 68 days respectively for methods (a), (b) and (c).

Cows in five different herds were recycled by method (a). Length of time post-injection to estrus did not differ significantly among herds nor was it influenced significantly by the day of initiation and the duration of injections or by superovulation.

Differences between 59 recycled cows and 53 controls, with respect to rate of conception, were not significant nor were differences between first and second post-recycling services.

Purified HFSH and HLH effectively produced superovulation in mature and immature as well as pregnant bovine females. Sixty-one of 75 cows and calves ovulated and produced 1716 ovulation points, ranging from one to 88 with a mean of 28.13. The right ovary produced 53.03 percent of all ovulations. Calves produced significantly more ovulations than did cows. Neither the addition of prolactin to the ovulatory injection of LH nor the administration of ovulatory injections for two consecutive days proved advantageous.

Sixty percent of all superovulated cows exhibited estrus. Recycling with progesterone or by corpus luteum removal resulted in a significant increase in the number of cows manifesting estrus.

The "slaughter" technique was employed to recover both superovulated ova and those resulting from single points of ovulation. Ova were recovered from 89.19 percent of all slaughtered animals that ovulated. Percentage recovery of superovulated ova was 39.97 percent. Recovery of ova produced by single points of ovulation was accomplished in 11 of 13 attempts for a percentage of 84.62 percent.

No significant difference was found between cows and calves with respect to the percentage of superovulated individuals that yielded ova. Percentage recovery of ova was significantly greater from superovulated cows than from superovulated calves. Average numbers of ova recovered were virtually equal however, being 11.60 for cows and 11.34 for calves. Percentage recovery tended to decrease as total numbers of ovulation increased.

Chromic oxide, glass beads and ova were recovered by a "live-flush" technique which was greatly augmented by epidural anesthesia.

The relative merits of calf and cow ova, with respect to fertilization, were observed. No difference existed between cows and calves with respect to the percentage of individuals from which fertilized ova were obtained but percentage fertilization of cow ova was significantly greater than that of calves. The effects of incidence of heat, actively secreting corpora lutea, and auxillary treatment with progesterone or diethylstilbestrol were also investigated, leading to the attainment of luteal phase fertilization. Fertilization was also accomplished by the intraperitoneal deposition of semen.

A number of superovulated cows were bred for observation of resulting pregnancies. Five such pregnancies occurred with number of embryo recovered ranging from one to seven.

Thirty transfers of bovine ova were made. Superovulated as well as ova from single points of ovulation were transferred by both surgical and non-surgical means. Two transfers entailed the use of follicular ova. None of 26 non-surgical transfers, made cervically, rectally, and by depositing ova within the peritoneal cavity, definitely resulted in pregnancy. Of four surgical transfers performed, one resulted in pregnancy and terminated in the full term birth of a 98 pound bull calf.

Microfilm $2.75; Xerox $7.80. 168 pages.

EFFECTS OF CAFFEINE ON THE PHYSIOLOGY AND CHROMOSOME BEHAVIOR OF THE CILIATE, TETRAHYMENA PYRIFORMIS.

(Order No. Mic 61-1459)

James David Eisen, Ph.D.
Emory University, 1960

Director: W. D. Burbanck

The role of chromosome aberrations and mutations in carcinogenesis was discussed, along with the ability of a number of compounds to be mutagenic in a variety of

organisms. Caffeine, a methylated oxypurine, in addition to being mutagenic to Drosophila, Escherichia coli, and Ophiostoma, is known to induce chromosome aberrations in Allium cepa and Lilium tigrinum.

The purpose of this investigation was to determine the effects of caffeine on the physiology and chromosome behavior of two strains of Tetrahymena pyriformis. The strains, N-57-67-3-(A7) and N-57-64-8-(B8), variety 1, mating types I and II respectively, were cultured axenically in 1% (w/v)tryptone-proteose-peptone medium buffered at pH 6.6 and incubated in the dark at 25±.5°C. Aseptic techniques were employed in all procedures. The responses of both strains to buffered 10^{-3}M, 10^{-4}M, and 10^{-5}M caffeine concentrations (in standard medium) were tested; the 10^{-1}M and 10^{-2}M concentrations were lethal and could not be employed. Controls in all cases were run in the non-caffeine medium.

The effect of caffeine on chromosomes was determined by microscopic examination of fixed and stained specimens of conjugating Tetrahymena in meiosis. After 24 hours exposure to the alkaloid, no chromosome aberrations were observed.

The physiological effects of caffeine were determined, using the criteria of growth and respiration. Total population growth, or increase in biomass, was measured turbidometrically. As this test simultaneously measured all the factors involved in growth, separate determinations were also made to establish the effects of caffeine on daily fission rates, cell volumes, dry weights, and protein content, these being individual components of the growth phenomenon. The effects of caffeine on oxygen consumption were determined through the use of both the Warburg and Cartesian diver techniques.

This investigation demonstrated that the rate of population growth and the total growth of both Tetrahymena strains were inhibited by the 10^{-3}M caffeine concentration. The effect of caffeine at this concentration was to inhibit metabolic activities, an action which was manifested in a reduced daily fission rate and oxygen consumption. As a possible result of these two factors, cell volumes were increased.

Tetrahymena grown in concentrations of 10^{-4}M caffeine had the highest rate of population growth and total growth for both strains. This concentration stimulated metabolic activities, an action which was manifested in an increased daily fission rate and oxygen consumption. As a possible result of these two factors, cell volumes were reduced. The 10^{-5}M concentration had no effect upon the growth of either strain, as the physiological responses did not differ significantly from those of the controls in any of the experimental procedures.

When cell volumes were increased by the 10^{-3}M, or decreased by the 10^{-4}M concentrations, the dry weight and protein per million organisms were also increased or decreased respectively. However, the percentage of protein per mg dry weight was essentially the same in all caffeine concentrations and in the control, indicating that the effect of caffeine was on the rate of protein production.

Caffeine in any of the three concentrations used did not affect the daily fission rates genetically, nor did it induce "Dauermodifikationen." On the basis of the inability of the alkaloid, in the concentrations used, to induce chromosome aberrations or genetic effects, it was concluded that caffeine was not mutagenic to Tetrahymena pyriformis.

As a result of analysis of the separate factors comprising the phenomenon known as growth, the conclusion was reached that caffeine at the 10^{-3}M and 10^{-4}M concentrations affected the intermediary metabolism of the ciliate, interfering with the rate of respiration and protein production. It was suggested that the inhibitory effects of caffeine at the 10^{-3}M concentration were due to the inactivation of enzymes by the N-methyl groups in the caffeine; no explanation, however, was offered for the stimulatory effects at the 10^{-4}M concentration. The borderline molarity of caffeine for cellular response was between 10^{-4}M and 10^{-5}M.

No statistical differences were observed between the cytological and physiological characteristics of the two strains. Microfilm $2.75; Xerox $4.40. 83 pages.

THE EFFECTS OF HERBICIDAL CHEMICALS ON THE ACTIVITY OF TERMINAL OXIDASE ENZYMES IN PLANT TISSUES

(Order No. Mic 61-2290)

Kenneth Lee Hill, Ph.D.
North Carolina State College, 1960

Supervisors: Donald Edwin Moreland and
Glenn Charles Klingman

The distribution of cytochrome oxidase, polyphenol oxidase, and ascorbic acid oxidase in the root and foliage tissues of corn [Zea mays (L.), pedigree Kys x C 1.21] and soybeans [Glycine Max (L.) Merr., variety Lee] was determined.

All three enzymes were isolated from both the root and foliage tissues of soybeans. Cytochrome oxidase was present in both the roots and foliage of corn. Polyphenol oxidase was obtained from corn foliage tissue but not the roots while ascorbic acid oxidase activity was found in corn roots but not the foliage tissue.

The effect of various herbicides on the activity of the terminal oxidases under in vitro conditions was studied. Compounds representative of several major herbicidally important chemical families were tested in these studies. None of the herbicides affected the activity of ascorbic acid oxidase at the concentrations tested (generally 1 x 10^{-3}M). Polyphenol oxidase activity was reduced slightly by 1 x 10^{-3}M 3-(3,4-dichlorophenyl)-1,1-dimethylurea (diuron). Diuron; pentachlorophenol (PCP); isopropyl N-(3-chlorophenyl)carbamate (CIPC); and isopropyl N-phenylcarbamate (IPC) inhibited the activity of cytochrome oxidase from both corn and soybeans. Enzymes from both species responded in a similar manner to the herbicides.

Corn and soybean plants, grown in nutrient cultures, were treated separately, with 2,4,5-trichlorophenoxyacetic acid (2,4,5-T); IPC; and diuron, to determine their effect in vivo on the activity of the terminal oxidases in both the root and foliage tissues. Two concentrations of each herbicide, which were sublethal to the plants but produced definite morphological responses, were used.

Preparations of the three enzymes were made at two-day intervals from the treated plants and their activity compared to that of preparations from untreated plants. Comparisons of enzyme activity in treated plants to that of untreated plants were made on both a fresh weight and protein basis.

Significant differences in the responses of the terminal oxidases were obtained at various stages of plant growth as a result of herbicide treatments. The differences were not consistent in that the activity of a given enzyme in treated plants might be significantly higher than that in untreated plants at one growth period, but significantly lower or show no significant difference at another growth period. Observed differences were partially dependent on whether comparisons were made on a fresh weight or protein content basis. Significant differences obtained on a fresh weight basis were often reversed or eliminated when comparisons were made on a protein content basis.

Results obtained in these studies indicate that the responses of the terminal oxidases in corn and soybeans to herbicide treatment were dependent on plant species, rate of herbicide application, location of the enzymes in the plant, and on the growth period of the plants.

Interpretation of the results obtained has been attempted. Microfilm $2.75; Xerox $7.20. 153 pages.

RE-ENTRANT DUODENAL FISTULA TECHNIQUES: APPLICATION TO THE STUDY OF DIGESTION AND PASSAGE IN THE BOVINE ALIMENTARY TRACT.

(Order No. Mic 61-2702)

A. Dare McGilliard, Ph.D.
Michigan State University, 1961

Major Professor: C. F. Huffman

A preliminary study was conducted to develop a satisfactory procedure for measuring total output of ingesta from the upper gut. The procedure adopted was used to partition digestion in the upper from that in the lower gut.

Operative technique for establishing a re-entrant duodenal fistula in the bovine was developed. Equipment was designed for the total collection of ingesta from the upper gut and its return to the lower gut. Passage was measured using three methods: I – none of the collected ingesta was returned to the lower gut; II – all of the ingesta obtained during each 15-minute period was returned to the lower gut at the end of the period; III – ingesta was continuously returned to the lower gut at about the same rate as it was collected. All collections commenced with feeding, were of 6 hours duration and consisted of consecutive 15-minute and hourly sampling periods. Ten pounds of a 70% alfalfa hay-30% ground corn diet was fed once daily throughout the study.

Fistulation appeared to have no marked influence on digestive ability. Ingesta passed from the upper gut at irregular but relatively frequent intervals. The return of large amounts of ingesta to the lower gut reduced or stopped flow for a period of time. Passage was most rapid during eating but decreased with time thereafter. The total output, solids content and pH of ingesta appeared to be related to the extent of dilution in the abomasum. Abnormal behaviour during collections was observed when methods I and II were used. Flow of ingesta with method II was highly variable. Passage of the organic components and their decline after feeding was markedly accelerated with method I. The least variation within and between collections occurred with method III; behaviour of the animal was normal.

The steer used in the preliminary study was also used for the second part of the study. Four diets consisting of various alfalfa hay : ground corn ratios (10:0, 7:3, 3:7, 0:10) were fed at constant intake (10 lb./day) either once or twice daily. Total digestion was determined by the ratio technique using chromic oxide as a marker. Digestion in and passage from the upper gut was determined by total collection of ingesta passing from the proximal duodenum over a 24-hour period; the 'continuous' method of collection was used. Digestion in the lower gut was determined by difference.

From 23-55% of the dry matter was removed in the upper gut and 25-48% was removed in the lower gut. Proportionately less dry matter was digested in the upper gut and proportionately more was digested in the lower gut with mixed diets than with corn or hay alone. Non-dietary nitrogen, ether extract and ash were added to ingesta in the upper gut; removal of these fractions largely occurred in the lower gut. Losses in the upper gut were almost entirely due to removal of the carbohydrate fractions.

Flow of ingesta from the upper gut was essentially continuous with each diet. Ingesta pH was not influenced appreciably by diet or frequency of feeding. An estimated net increase of 38-54 l. of water occurred in the upper gut. Passage was most rapid with the high-corn diet and was followed in order of decreasing rate by the high-hay, all-hay and all-corn diets. Passage was accelerated during eating and reduced by rumination and more frequent feeding. Output of ingesta decreased with time after feeding. Decrease of the carbohydrate fractions was relatively more rapid than that of protein or ether extract. Physiologically, the animal was undisturbed by the 24-hour collection procedure.

Microfilm $6.75; Xerox $23.85. 530 pages.

LOW TEMPERATURE TOLERANCE OF INSECTS IN RELATION TO THE INFLUENCE OF TEMPERATURE ON MUSCLE APYRASE ACTIVITY

(Order No. Mic 61-2152)

John Alexander Mutchmor, Ph.D.
University of Minnesota, 1961

This study documents certain relationships between the influence of temperature on the rate of muscle apyrase activity of a number of poikilothermic animals, and its effects on the activity of the animals as a whole. Correlations were sought which might account for the ability of some insects to remain active at temperatures causing inactivation or chill-coma in others. The rate of apyrase activity of species differing in cold-tolerance and habitat temperature was therefore compared. Chill-coma temperatures were used to describe the relative cold-tolerance of the animals. Muscle apyrase determinations were made with the housefly, Musca domestica; the sarcophagid fly, Sarcophaga bullata; the waxmoth, Galleria mellonella; the giant death's head roach, Blaberus craniifer; warm-, cold-, and unadapted American cockroaches, Periplaneta americana; warm- and cold-adapted mealworms, Tenebrio molitor; the crayfish, Cambarus diogenes; and the

horseshoe crab, Limulus polyphemus. The results were presented chiefly as Arrhenius plots and compared in terms of absolute rates of apyrase activity and temperature coefficients (μ-values).

Differences in the effect of temperature on the rate of apyrase activity of different species were clearly correlated with differences in cold-tolerance. At given low temperatures the rate was generally higher in animals with the lowest chill-coma temperatures, and higher temperature coefficients were associated with the more cold-tolerant species. However, at temperatures 3° to 4°C above the respective chill-coma temperatures, the rate of apyrase activity was nearly the same in each species (0.4 ∓ 0.1 μg.P/mg muscle/minute). The relationship between chill-coma temperatures and temperature coefficients was linear; in the insects, 1°C difference in coma-temperatures was equivalent to a difference of about 2,400 cal. in μ-value.

Curves of apyrase activity had maxima at lower temperatures in the more cold-tolerant species, and the maxima were higher in species that might be regarded as normally most active. In an intraspecific comparison apyrase activity at given temperatures was greater in cold-adapted than in warm-adapted P. americana; however, adaptation appeared to have little or no effect on the temperature coefficients of apyrase activity. The effects of temperature on the apyrase activity of mitochondrial suspensions from muscle of the housefly and the American cockroach were compared with the activity of the corresponding muscle homogenates. The temperature coefficients of the latter were found to be substantially lower.

It was concluded that higher apyrase rates and temperature coefficients in the more cold-tolerant species, and the occurrence of a common rate of apyrase activity at temperatures 3° to 4°C above the respective chill-coma temperatures, might constitute an important mechanism of adaptive compensation for maintenance of activity at low temperatures.

Microfilm $2.75; Xerox $4.20. 76 pages.

METHODS OF DETERMINING THYROID SECRETION RATES IN DAIRY CATTLE

(Order No. Mic 61-2190)

Theodore Beemer Post, Ph.D.
Rutgers University, 1961

Major Professor: Dr. John P. Mixner

Radioactive and chemical thyroxine turnover procedures were adapted in dairy cattle to provide methods of determining thyroid secretion rates that were more rapid and less restricted in application than other commonly employed radioisotope methods. Preliminary studies indicated that the average purity of different lots of I^{131}-L-thyroxine used in these studies was 94%, the PBI assay procedure used was 96% effective in recovering thyroxine iodine, and the radioactivity counting errors were less than 2%. In the main study radiothyroxine in the blood was found to be confined to the plasma proteins. The turnover rate of radiothyroxine was not influenced by the recycling of I^{131} during the first 120 hrs. after injection. For radiothyroxine turnover methods of determining thyroid secretion rate, a tracer amount of I^{131}-L-thyroxine (50 uc. in calves, 250 uc. in cows) was injected intravenously. Thyroid secretion rates were calculated from the exponential decline in plasma I^{131}, plasma protein I^{131}, or the specific activity of plasma PBI in daily blood samples collected over the next 4 days. The preferred radiothyroxine turnover method was the one based on specific activity of PBI (isotope dilution procedure), because it measured thyroxine secretion more directly and was independent of changes in body fluids and of the recovery of thyroxine iodine in PBI determinations. In a chemical thyroxine turnover method of determining thyroid secretion rate, a single large dose of stable L-thyroxine (5 mg. in calves, 25 mg. in cows) was injected intravenously. Thyroid secretion rate was calculated from the exponential decline in total plasma PBI in blood samples collected over the next 3 days. The chemical method was evaluated by within animal comparisons with the isotope dilution method in 14 dairy bull calves and four non-lactating mature cows. The mean daily thyroid secretion rates per 100 lb. of body weight obtained by the chemical method in calves (0.358 mg.) and in cows (0.134 mg.) were statistically similar to those determined in calves (0.383 mg.) and cows (0.144 mg.) by the isotope dilution method. There was a coefficient of correlation of 0.93** between thyroid secretion rates obtained by the two methods in calves. Error coefficients of variation of daily thyroid secretion rates calculated from duplicate determinations in cows were 9.65 and 11.45% for the isotope dilution and chemical methods, respectively. The validity of the thyroxine turnover methods was supported by the similarity of their mean estimates of daily thyroid secretion rates in four cows to that (0.129 mg. per 100 lb. of body weight) obtained by a widely accepted, but more time consuming, replacement method based on the thyroxine inhibition of thyroidal I^{131} release.

In less extensive related studies, typical rate constants were obtained for the metabolism of radioiodide in a dairy cow; the gastrointestinal absorption efficiency of L-thyroxine, determined by comparing the maximum plasma PBI increases after intravenous and oral administration of stable L-thyroxine, was similar to that determined by comparing the maximum plasma PBI^{131} levels after the intravenous and oral administration of I^{131}-L-thyroxine in two bull calves; the turnover of I^{131}-L-triiodothyronine in one bull calf, based on the disappearance of plasma PBI^{131}, was about three times more rapid than that of thyroxine; and the in vitro red blood cell uptake of I^{131}-L-triiodothyronine appeared to be positively related to thyroid secretion rate and plasma PBI and negatively related to total plasma protein levels in four cows.

Microfilm $3.80; Xerox $13.30. 295 pages.

THE EFFECTS OF PARENTERAL TRYPSIN THERAPY FOR SPINAL CORD HEMISECTION IN SHEEP

(Order No. Mic 61-2513)

William John Tietz, Jr., Ph.D.
Purdue University, 1961

Major Professor: G. D. Goetsch

Fifty-four sheep with experimental spinal cord damage were subjected to therapy either with the proteolytic

enzyme trypsin, administered intravenously or intramuscularly, with x-radiation, or with intramuscularly administered prednisolone. Eighteen additional sheep with the same spinal cord damage served as controls and were either not treated or received intravenous or intramuscular injections of saline.

The post-operative clinical performance of the sheep was followed for seven to 143 days. The length of time required for sheep to rise and walk without assistance seemed to be shortened in the group which received trypsin therapy. However, the final performance of the sheep surviving 143 days did not seem to be affected by any of the therapeutic regimens. Some of the sheep underwent clinical regression after various periods. A slight transient depression appeared to result from intravenous trypsin administration.

The microscopic analysis of the spinal cord lesions revealed that the spinal axons of sheep are able to regenerate to the point of entering the area of scarring. The greatest potential for regeneration appears to lie in the axons of the segment of cord caudal to the cord defect, as well as in the peripheral and medial tracts of both cranial and caudal cord segments. Scar tissue deposition appeared to be inhibited in sheep treated with trypsin but not in any of the other therapy groups. Axon regeneration was fostered by both trypsin therapy and by x-ray therapy.

Blood studies conducted on the treated sheep indicated that none of the therapeutic regimens affected white cell levels, red cell levels, hemoglobin concentration, or hematocrit levels. Plasma glutamic-oxalacetic transaminase studies of normal and treated sheep revealed that only intramuscular trypsin caused increased blood levels of the enzyme.

Attempted sensitization to trypsin of six normal sheep by repeated intramuscular injections of 100 mgm for six days was not successful. Subsequent challenge with 100 mg of trypsin intravenously administered revealed no changes in blood constituents, body temperature, or clinical appearance which could be attributed to a sensitization reaction.

Pharmacological studies of the effects of intravenously administered trypsin were conducted in ten anesthetized sheep. Dosages as small as 0.22 mg per kilogram body weight were found to be capable of producing a measurable decrease in blood pressure. The degree of blood pressure decrease appeared to be related to dosage and to rate of administration. Total doses of 100 mg of trypsin produced marked transient depression of blood pressure, respiration, and the electrical activity of the brain.

Microfilm $2.75; Xerox $9.70. 211 pages.

STUDIES ON THE CAROTID SINUS BAROCEPTORS WITH PARTICULAR REFERENCE TO ENDOTOXIN SHOCK

(Order No. Mic 61-2161)

John Walter Trank, Ph.D.
University of Minnesota, 1961

The animal in endotoxin shock presents a circulatory picture which cannot be explained totally on the basis of the direct vascular effects of endotoxin or the chemical mediators released by the animal following endotoxin administration. The component or components of the total endotoxin shock picture in the dog which may be attributed to the modifications of the barostatic hemoregulatory reflexes following endotoxin poisoning have been studied. In particular, the study deals with the characterization of canine carotid sinus baroceptor responses and the modifications induced in these responses following the onset of endotoxin shock.

The baroceptors are characterized with regard to their responses to (1) steady pressures applied for periods of time appreciably longer than the receptor adaptation time, (2) rapid pressure steps, and (3) sinusoidally varying pressures. The baroceptor response to steady and pulsating pressures is characterized as the specific transfer function, the graphic relationship between mean intrasinusal pressure and baroceptor nerve discharge frequency. Its response to rapid pressure steps is characterized as the step sensitivity, a normalized measure of the transient component of the discharge pattern following a step pressure change. A technique designed to facilitate this sinus characterization is described in detail. It comprises an animal preparation, an analog tape recording system, a controlled perfusion system, and a pulse counting frequency meter.

The steady state transfer function is sigmoid shaped, rising slowly at low pressures (below 80 to 90 mm Hg), rapidly in the range between 90 and 150 mm Hg, and then slowly above 150 mm Hg. These are approximate values given as examples only, because there are large variations between individual animals. The pulsatile transfer function in contrast to the steady state is more linear over a wider pressure range. In the low pressure range it lies above the steady state function, thereby indicating a higher sensitivity to pulsatile pressure. As pressure is increased, the two curves approach, and in the higher pressure ranges the pulsatile transfer function lies upon or below the steady state curve.

The baroceptor discharge response to a step pressure change consists of the sum of a steady state term and a transient term. The steady state discharge frequency is dependent only upon the final pressure following the step whereas the transient discharge frequency is related directly to the sign and magnitude of the step and exponentially to time. The response to rapid pressure changes, characterized as the step sensitivity, shows a maximum in the vicinity of 120 mm Hg.

Following the onset of endotoxin shock, the baroceptor responses are modified in the following manner: (1) the steady state transfer functions are shifted to the left 15-30 mm Hg, (2) the step sensitivity maxima are shifted to the left 10-15 mm Hg, and (3) the pulsatile transfer functions are shifted to the left 14-30 mm Hg.

These shifts, indicating an increased sensitivity to pressure and dP/dt at low pressures, result in a lowering of the "set" of the barostat so that pressure will be regulated at a new and lower level. The net result is that after endotoxin the heart rate and vasoconstrictor control mechanisms fail to correct the hypotensive effect of the agent.

It is shown that it is most likely that endotoxin produces these modifications indirectly through a chemical mediator released by the animal in response to the endotoxin challenge and furthermore that it is most likely that the effect is one of receptor sensitization or modification of the physical properties of the sinus wall rather than direct receptor stimulation.

Microfilm $2.75; Xerox $8.00. 174 pages.

POLITICAL SCIENCE, GENERAL

THE VOLUME AND STABILITY OF INTRAPARTY CONSENSUS IN THE HOUSE OF REPRESENTATIVES DURING FOUR RECENT CONGRESSES

(Order No. Mic 61-1590)

Lee Franklin Anderson, Ph.D.
University of Illinois, 1961

This study is an analysis of roll call voting in the U.S. House of Representatives during the 80th, 81st, 83rd, and 84th Congresses. The aims of the research are twofold. First, it examines the effects of three factors upon the volume and stability of the consensus manifested by the voting structures of the congressional parties. Second, the study seeks to evaluate the usefulness of Guttman scale analysis as a means of measuring the stability of legislative voting.

Volume of consensus refers to the level of agreement existing within the legislative parties on issues of public policy. The cohesiveness of the parties is taken as indicative of that level. Stability refers to the tendency of a party to split into sub-party blocs over a series of issues. The fewer the blocs and the larger the blocs, the more stable is a party's voting structure.

These two properties of congressional voting are examined in terms of the effects of three factors: the substance of the issues voted upon, the majority-minority positions of the parties in the Congress, and the party control of the presidency.

Substantive differentials are evident in both party cohesiveness and stability. Moreover, while party unity and stability vary from type to type of issue, the patterns of variation differ between the parties. Furthermore, Republican voting appears to be more sensitive to changes in the content of the votes taken. In contrast, Democratic structure is evidently more fixed and independent of the issues being voted upon.

Shifts in the majority-minority positions of the parties apparently affect the cohesion and stability of the parties in some areas of public policy but not in all. It was found that in areas in which a clear association exists between variations in the two properties and alterations in party position, majority status tends to increase a party's unity and stability. Minority status appears to give rise to a more uncohesive and unstable voting structure. Interparty differences in the relative effect of majority-minority shifts were also evident. In general, Republican structure is more affected by shifts in party position.

In general, changes in party control of the presidency appear to be less significant than alterations of party position in the Congress. In only one area of public policy, foreign policy, are significant fluctuations in party unity associated with changes in the White House. Stability appears to be comparatively more affected by this factor. The evidence indicates that at least in some areas of public policy the parties manifest their greatest coherence of structure when in control of both the Congress and the presidency.

The second objective of this study is to evaluate the utility of Guttman scale analysis as a measure of voting stability. Its primary weakness lies in its incapacity to necessarily discern non-dimensional patterns of stable voting. However, while such patterns may be evident on a limited number of votes, it is doubtful that a single system of non-dimensional stability extends over a large series of votes. Hence the relative scalability of a set of issues can probably be taken as a fairly reliable index of the parties' stability.

By comparison to non-dimensional measures of stability such as Beyle-Rice cluster bloc analysis, Guttman scaling appears to have two primary merits. First, it enables a consideration of content in a manner that avoids some of the arbitrariness of treatments depending entirely on a priori classifications of subject matter. Second, it enables a detailed analysis of several facets of legislative stability.

Microfilm $3.30; Xerox $11.70. 256 pages.

THE BELGIAN ROYAL QUESTION, 1940-1950: CLEAVAGE AND CONSENSUS IN SOCIETY AND POLITICS.

(Order No. Mic 61-2250)

Ergasto Ramôn Arango, Ph.D.
The University of Florida, 1961

On May 10, 1940, the Germans invaded Belgium. Fifteen days later, when defeat appeared certain, the Belgian government fled into exile so that it might carry on the war from France and later from England. Contrary to the pleadings and advice of his Ministers, the Belgian king, Leopold III, chose to stay in Belgium and share the fate of his army and his subjects. Three days later, on May 28, Leopold, acting in his capacity as Commander-in-Chief of the armed forces, capitulated to the enemy and was taken prisoner. He remained a captive until May, 1945. The separation of King and Cabinet on May 25, 1940, marked the beginning of what the Belgians call the royal question which came to an end on August 1, 1950, when Leopold III abdicated in favor of his son, Prince Baudouin.

Essentially the royal question is the final episode in a long-developing constitutional dispute over conflicting interpretations of monarchical power under the Belgian constitution. The Constitution divides power generously between the King and Parliament, but political power during the last years of the 19th century and during the 20th century came increasingly to lie in Parliament, due primarily to the growth of responsible political parties. The Constitution had not been amended to reflect this political

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

change, however. This change was evident only through custom and the evolving "rules of the parliamentary game." After the accession of Leopold III to the throne in 1934, but before war came to Belgium in May, 1940, domestic and international circumstances forced the King to act, contrary to the evolving rules, with the full authority which was his under the Constitution.

Leopold believed that his capitulation and his behavior during the occupation also lay within his constitutional authority. The exiled Government thought otherwise. After the war, both the King and the Government sought from the Belgian people vindication of their respective positions. The Ministers believed that they had been right to continue the war from beyond the borders of Belgium; the King believed that he had been right to surrender his troops in order to prevent their annihilation by what appeared to be an invincible enemy. Vindication of these decisions and their consequences carried with it, however, vindication of a particular interpretation of monarchical authority under the Constitution. Can the King make and execute a decision contrary to the advice of responsible ministers? To answer the question affirmatively would vindicate the King. To answer the question negatively would vindicate the Government and relegate the King and his successors to a position of authority comparable to that of other modern constitutional monarchs. This position would follow those "rules of the game" which had been partially in suspension since the accession of Leopold III. The future relationship between Belgian sovereigns and their ministers--in fact, the future of the constitutional monarchy in Belgium--depended on the outcome of the dispute.

The purpose of this study is to show the monarchy as it existed before the royal question (1935-1940); to present the events that made up the question itself (1940-1944); to describe the battle between the King and the Government as each sought to win the approval of the people (1945-1947); to reveal the solution of the royal question (1949-1950); and finally to speculate on the nature of the monarchy after 1950, on the significance of the ten-year affair on the future relationship between Belgian sovereigns and their governments, and on the relevance of the Belgian experience for an understanding of the role of a constitutional monarch in modern democratic society.

Microfilm $3.75; Xerox $13.05. 289 pages.

CODETERMINATION AND THE WEST GERMAN TRADE UNIONS

(Order No. Mic 61-1399)

George R. Crossman, Ph.D.
Columbia University, 1961

The struggle for and the practice of codetermination in the West German iron, steel and mining industries has had a number of significant effects upon the relationships of the West German trade unions to the industries operating under codetermination. Having become the major ideological program of the predominant Free Trade unions during the Weimar Republic, it was strongly reinforced by the conclusions which the trade union leaders of all backgrounds drew from their experience with the failure of Weimar democracy.

These ideas were accordingly brought forward into the post-1945 period, and soon formed the basis for serious union-management negotiations. On the basis of these discussions, codetermination was incorporated into the new reorganized iron and steel companies established under the auspices of the British trustee administration beginning in 1947. With this new experiment codetermination again became the focal point of trade union ideology, and by 1948 had become their major post-war program.

With the establishment of the West German government in 1949 and the emergence of an over-all plan to reorganize the West German iron, steel and mining industries, the West German trade unions turned to politics to reinforce their gains. An intensely bitter conflict with management, involving a major strike threat in these industries in January 1951, resulted finally in government action to initiate codetermination legislation, and the passage of the Codetermination Law for the Iron, Steel and Mining Industries established codetermination in virtually the entire iron, steel and mining complex in West Germany. This victory was followed, however, by a trade union attempt in 1952 to repeat this performance with regard to legislation for all industry, and was met with failure and trade union bitterness.

The results of this long struggle to establish codetermination and to reinforce it with legislation were a deepening of mistrust between the West German trade unions and the industrialists, the pronouncement of the political strike as illegal, a waning of union influence with government, and a loss of public support. Yet despite this defeat the trade unions found themselves too deeply committed to codetermination to modify their demands for it. Handicapped by contradictory arguments in its support, and lacking the power to do more than fight to preserve it in its present form, the unions have been compelled to adopt a basically defensive posture on one of the fundamental elements of their contemporary program.

Turning to the effects of the practice of codetermination, no conclusive evidence is available to indicate on balance the effect of codetermination upon trade union relationships with their members in the codetermination enterprises. In the area of trade union relationships with management, however, some clear effects are discernible. Within the boards of managers of the codetermination enterprises, the trade unions are faced with the problem of supporting the labor directors in their attempt to gain acceptance from their management colleagues. As a consequence the trade unions have not found that codetermination has provided them with a strong controlling influence over board policies. On the contrary, the trade unions have found themselves forced to refrain from any attempt to exercise such influence. Similarly, within the supervisory boards of the corporations the trade unions have been compelled to adopt a policy of cooperation. By virtue of these developments, the trade unions have found themselves involved in attempts to alter the legal power of these boards in order to strengthen their position. Similarly, to reinforce codetermination, they have found that they must become involved in questions of industrial reorganization, particularly with regard to the progressive reconcentration of West German industry.

Finally it is clear that the practice of codetermination has produced two new tensions within the trade union federation. First, within the powerful metal workers union a polarization of conflict has appeared between the national

headquarters in Frankfurt, and the regional office in Düsseldorf which is responsible for the codetermination industries. Second, pressure has emerged from the labor directors upon the federation leadership for a more moderate policy concerning collective bargaining procedures in the iron, steel and mining industries.

It is clear therefore that significant changes in the relationships between the unions and the codetermination industries have occurred as a direct result of codetermination. All evidence indicates that these relationships will continue to be influenced to a critical extent by codetermination, and that an analysis of union relationships with these industries will require a thorough understanding of the history and continuing development of the practice of codetermination.

Microfilm $3.95; Xerox $13.75. 305 pages.

PERSONALITY AND POLITICS: A QUALITATIVE ANALYSIS OF THE BASIC FACTORS OF POLITICAL SUCCESS.

(Order No. Mic 61-1486)

Steven Ebbin, D.S.S.
Syracuse University, 1960

Supervisor: Frank Munger

The purpose of this study was to isolate, describe and analyze the central characteristics of personality that are common to the politically successful. We sought to distinguish the successful from the electively unsuccessful, believing basically that it is a feature or set of features of the personality that differentiates between the two classes of political success seekers. Almost standing above this purpose was the desire to re-stimulate the use of personality studies by behavioristically inclined political scientists in the explanation of election phenomena. This we found to be a fruitful, yet relatively untapped source of information of great interest to the behaviorist.

The fashion in political science, even among behaviorists, has been to concentrate on the employment of quantitative studies, the qualitative methodology having been largely ignored. While the quantitative method has proven to be most useful in the analysis of election materials, it certainly cannot be used where it does not apply. We hope that we have suggested a basis for the use of that method.

The study consisted of interviewing a sample of six active politicians in the State of Connecticut, all of whom had stood for election several times. The data consisted of a verbatim report of these depth interviews which lasted between 8 and 20 hours each. The questions, while structured in their presentation, allowed for interpretation by the interviewer. It was hoped that these responses would permit categorization, but, because of allowances for free response, this was not always the case. There were also several questions that some of the respondents either refused flatly to answer, or were ignored. Where this was the case, the fact was noted. The study included also a bibliographic survey of the materials that have been accumulated in the general field of leadership, based upon the belief that the factors of political success are related to the factors of adequate leadership.

The interview results were analyzed in an attempt to isolate those components of the personality that are common to the electively successful, but not to the unsuccessful. This was done in the belief that it is the personality of the candidate, rather than situational factors, that lead to his success. An inductive classification method was employed.

We are aware that the results of our work do not point to immutable laws of political success. However, we believe that the value of this study lies in the direction in which it points, re-opening a real and important area of study, dormant for the most part since the 1930's, and setting forth a hypothesis that if tested on a quantitative basis, might aid in the discovery of the components of the successful political personality.

The findings of this study fall into two major categories: objective factors and subjective factors. The former refer to characteristics that the interviewer can see or directly measure, e.g., traits of height, weight, looks, intelligence, etc. On this count there seems to be no significant differentiation between the successful and the unsuccessful. It is true that they seem to be factors prerequisite to success, but do not distinguish between the two categories of success seekers.

Subjective factors here refer to attitudinal factors. In the analysis of the interviews a number of possibilities were tested out. Many did not differentiate between success and failure. Thus, all acknowledged the quest for power as a motive for political activity; none seemed to be in politics for economic motives; all perceived success as highly insecure with "luck" an important ingredient in success; all admitted that one of the pleasures of politics was a sense of recognition, being in the limelight, etc. There was, however, some difference of motivational rationalizations between the successful and unsuccessful in the following categories:

1. Family Tradition. The four successful politicians all credited their ancestors with having motivated them to politics. The two unsuccessful minimized the significance of family influence insofar as politics are concerned.
2. Partisanship. The two unsuccessful politicians focused on this. In one case, though, in a negative respect. The four successful appeared to minimize party considerations and were much more tolerant of the opposition party.
3. Personalities and Issues in Politics. The two unsuccessful candidates emphasized issues in their conversations, while the successful felt that the personality of the candidate was much more important.
4. Duty Concept. The unsuccessful candidates emphasized that their duty was to get things done in the way they think right, while the others saw it as a more generalized duty to their constituents.
5. Needs and Wants. This is closely interrelated with the interpretation that the subjects made in relation to the duty concept. The four successful see the dedication to the satisfaction of the needs and wants of their constituencies as their central motivation for being in politics, while the other two omitted this as one of their professed motivations.

6. Confidential Communications. One other difference in the two sets of interviews is worth noting, though it does not appear in the transcripts and its significance is difficult to understand. The four dealt with as successful politicians all spoke partially off the record while the other two did not.

Microfilm $4.15; Xerox $14.65. 324 pages.

THE INTERNAL REVENUE ACT OF 1954: POLICY AND POLITICS.

(Order No. Mic 61-1987)

Eugene Neil Feingold, Ph.D.
Princeton University, 1960

The federal tax system has not operated to reduce inequality of income and wealth in any major fashion, despite popular conceptions to the contrary. This study examines the federal tax structure to determine the manner in which the effect of the progressive rate schedules in our tax legislation is softened. It examines the tax legislative process to gain an understanding of the reasons why this has happened.

The general features of the tax legislative process are discussed in detail as they affected the writing and passage of our basic tax law, the Internal Revenue Act of 1954. One of the principal public issues in the passage of the 1954 Act, the relief of "double taxation" of dividend income, is examined in detail as an illustration of the extent to which economic facts, theory, and myth contribute to the tax legislative process.

The dividend taxation issue, however, is atypical of policy issues in tax legislation, in that it was extensively discussed during the passage of the 1954 Act. Other tax issues, more typical of the tax legislative process in that they were not extensively discussed publicly, are also examined in some detail.

Chapter I discusses the effect of the federal income tax on the distribution of income in the United States. Chapter II outlines the federal tax structure, and discusses the reasons why the progressive rates in the tax laws have a much smaller effect than might be expected. Chapter III discusses the tax legislative process, the institutions involved in it, and the people involved in the drafting and passage of the 1954 Internal Revenue Code. Chapter IV is concerned with the drafting and passage of the Code. Chapters V and VI are concerned with specific areas of tax policy. Chapter VII presents some conclusions about the national legislative process, with special reference to tax legislation.

Microfilm $4.30; Xerox $15.10. 333 pages.

PRESSURE GROUPS IN THE MISSOURI LEGISLATIVE PROCESS

(Order No. Mic 61-2283)

Roy Milo McClintock, Jr., Ph.D.
University of Missouri, 1961

Supervisor: Robert F. Karsch

The purposes of the dissertation are to determine and describe the extent and effectiveness of lobbying in the Missouri General Assembly. Groups, in order to be discussed systematically, are classified according to their major interests, and one or more groups within each of the eleven categories is examined.

The report of the Committee on State Legislatures of the American Political Science Association (American State Legislatures, Thomas Y. Crowell and Company: New York, 1954) said that the influence of interest groups in Missouri was weak in comparison with that of the political parties. No evidential comparison of the influence of pressure groups to that of the political parties is made, but the extent of pressure group activities suggests that they can hardly be called "weak."

Questionnaires were sent to all current members of the Sixty-eighth General Assembly, and to many former legislators. The response was very satisfactory, almost twenty-five per cent of the questionnaires being completed and returned. These provided valuable insight into the opinions the legislators have concerning interest groups and lobbyists. Interest groups and lobbyists are considered to be more helpful than harmful by most legislators, particularly in the supplying of information.

Further valuable material for the study was obtained from interviews with lobbyists and executive secretaries of the interest groups. In every instance, such representatives cooperated willingly, both in granting the interview and in supplying data and other information. In only a few cases did the writer feel he was getting something less than the true facts of a situation. Interviews with newspapermen, along with their news stories and features, helped to complete the pictures in these and other instances.

The methods designed to win and exercise influence in the legislature and among the general public are stated and explained. The methods used by Missouri lobbyists and interest groups appear to be just as varied and as sophisticated as in other states. Most of the methods used are perfectly legitimate, there being only occasional departures from what is generally considered proper.

Groups are also classified according to their organizational structure and manner of operation. The main criteria of classification are the extent of the discretion of the executive secretary, and the extent to which the policies of the groups are determined democratically.

One of the questions asked the legislators was whether they favored more regulation of lobbies and interest groups than is presently provided for. Answers indicated that a majority favored the enactment of a stronger lobby law. Provisions of lobby laws in other states are examined; of exceptional interest are the new laws or recent amendments in Wisconsin, Michigan, Illinois, and Texas.

Although nine conclusions are given, only the four principal ones are stated here. First, lobbying around the Missouri legislature is more influential than is generally realized. Second, the activities of the lobbyists have

lowered the confidence of many people in their legislature and representatives. Third, lobbyists in pursuit of the interests of their respective groups are inclined to disregard the more important interest of the people of the whole state. Fourth, all too many of the legislators overlook or ignore their oath of office which pledges them to not accept ". . . any money or other valuable thing for the performance or non-performance of any act or duty pertaining . . ." to their offices. (The Missouri Constitution, 1945, Article III, Section 15).

In addition to the conclusions, the dissertation carried two sets of recommendations, one dealing directly with the problems raised in the conclusions, the other relating to lobbying in general and pertinent improvements which could be made in the structure and operations of the legislature. Microfilm $5.95; Xerox $21.20. 467 pages.

THE INFLUENCE OF SOCIO-ECONOMIC FACTORS ON PARTY VOTE IN THE ITALIAN GENERAL ELECTION OF JUNE 7, 1953.

(Order No. Mic 60-6971)

Steighton Arthur Watts, Jr., Ph.D.
Michigan State University, 1960

Major Professor: Joseph LaPalombara

This study presents a statistical analysis of the Italian General Election of June 7, 1953. It was thought that Italian voters were motivated by certain socio-economic factors to support or oppose particular political parties. While it was impossible to measure the validity of this belief by interviewing individual voters, it was possible to accomplish much the same result by utilizing aggregate data from the 1951 Italian census.

This was accomplished by statistically correlating socio-economic variables (e.g., age, occupation, education) with the vote of each of the principal Italian parties. Using the correlation coefficients thus derived, the influence of each variable was analyzed and evaluated.

The present study begins with a summary of political events that took place between 1945 and the election of 1953. There is then a description of the campaign preceding that election, followed by a party-by-party discussion of the electoral returns. This discussion is in terms of the orthodox explanations of party support, i.e., international relations, legislative enactments, land reform, etc. Beginning with Chapter IV, the present study turns to the socio-economic analysis of the election.

The first variable deals with the extent of unemployment (or the level of employment). Employment is a major problem in Italy, and it was anticipated that this factor would have a profound and extensive impact on party vote. However, the correlations indicate that this is not the case; the amount of influence is slight.

The second major variable investigated, occupation, is much more productive. Four occupational categories are selected--agriculture, industry, service and public administration; the variable is further subdivided into agricultural and non-agricultural independents. It is found that occupation is an important factor in the electoral prospects of almost all parties (i.e., a difference between provinces in the percentage of the population engaged in a particular occupational category means a difference in party vote).

The next socio-economic factor analyzed is education. The educational level in Italy is discussed and found to be comparatively low; 89% of the population has no more than an elementary education, if that, and many persons are illiterate. It is found that the educational level of a province has a very considerable impact on the vote of the parties in that province. This makes possible some interesting speculations on the political effect of raising that educational level.

The next analysis deals with the influence of economic status on vote, using per capita income, home ownership and the number of persons per room as indicators. It is discovered that economic status is very dependent upon education and occupation and that its influence on vote is secondary to that of those two factors.

The final major variable investigated is age. This unquestionably is one of the most important factors analyzed, and the age structure of an Italian province is found to influence greatly the vote in that province. It is also found that some preconceptions about the radical character and tendencies of Italian youth need to be revised.

In addition to indicating the influence of these socio-economic factors on party vote, the correlation tables presented show that voter motivation and party support vary widely between the two northern and the two southern geographical regions. Most of the major parties have their support based on distinctly different types of appeal in these two areas. This fact indicates that generalizations on Italian electoral results must be preceded, or qualified, by a statement as to the geographical region under discussion.

In summation, the present study provides an analysis of the statistical correlations between party vote and selected socio-economic variables for the Italian General Election of 1953. The results of this study indicate that this method of investigation provides considerable insight into the electoral appeal of the various parties and, by implication, the motivation of Italian voters.

Microfilm $4.55; Xerox $16.20. 356 pages.

THE SOVIET COMMUNES

(Order No. Mic 61-2226)

Robert G. Wesson, Ph.D.
Columbia University, 1961

The Soviet communes, though varied, were mostly small voluntary associations of peasants with emphasis on brotherhood and equality. Their inspiration did not come from the Bolshevik program, nor the teachings of Marx or Lenin, who both believed in collective agricultural production but not in distribution by need until society should advance through socialism to a state of communist abundance. The idea of the commune was derived more from old peasant institutions, as the village commune and cooperative artels, the political programs of Populists, Socialist-Revolutionaries (especially those of the Left), and anarchists, and the anti-property sentiments of many religious

Sectarians, some of whom formed full communes before and after the Revolution.

Support for the commune ideal was strong in the lower ranks of the Communist Party and some government circles in 1918, but official policy turned increasingly away from the communes during following years. The first considerable number of communes was registered in 1918, when they were a majority of Soviet collective farms. Thereafter they were outstripped by less fully collectivized kolkhozy (artels and tozes) and declined proportionally and, in the NEP period, in absolute numbers. The usual size of communes was about 50 souls, mostly peasants of the poorer strata, also, especially in the first years, unemployed workers, refugees, and other landless persons. Their organization was supposed to follow a model statute officially issued and revised from time to time, but was usually informal. All production in the communes was collectivized, but only a minority had collective eating and nurseries for children. The usual rule of distribution was equal shares of the harvest for all. After 1925, the Party advocated with growing insistence the introduction of payment for labor, but this met much resistance.

The communes received considerable help from the Soviet government, rather more than other forms of kolkhozy, in the way of land, equipment, reduction of taxes, loans, and other attentions. Probably because of such assistance, the communes, although backward in livestock raising, were able to raise returns per hectare and per man well above those of individual peasants and somewhat above those of other kolkhozy.

Most communes had a substantial fraction of members in the Communist Party or Komsomol. For this reason, they should have been a ready tool of the Party, but they were remarkably little used. During the civil war, communes performed some semi-official functions, as grain requisitioning. Afterwards they were expected mostly to propagandize collective agriculture and had no official status.

During the Stalinist collectivization campaign, Party policy at first favored the communes, and they rose to their maximum numbers in 1930. They were used as centers of collectivization, and some were enormously expanded. In March, 1930, Stalin began a change of course, stressing the artel with individual households having garden plots and limited livestock as the proper form of kolkhoz. The Party became increasingly unfriendly to the communes, which decreased in numbers and became artels.

The commune form apparently was rejected in the collectivization campaign because of the difficulty and expense of establishing communes and the fear they inspired in peasants as a threat not only to all property but to the family. After collectivization was well advanced, even the best model communes were eliminated. Reasons for the final rejection of the commune form apparently were that they were out of harmony with Soviet and Stalinist philosophy, were opposed by tradition to the economic incentives then being stressed, and were consumption-minded and backward in delivery of grain. There has since been no sign of a revival of the name or form of the communes in the Soviet Union.

Microfilm $5.90; Xerox $20.95. 462 pages.

THE POLITICAL PHILOSOPHY OF GEORGE W. NORRIS

(Order No. Mic 61-2197)

Norman L. Zucker, Ph.D.
Rutgers University, 1961

Major Professor: Professor Edward McNall Burns

This dissertation outlines, analyzes, and relates the legislative achievements and political philosophy of Senator George William Norris (1861-1944) to the twentieth century American political reform tradition.

George W. Norris was the only legislator to serve continuously in Congress from the Republican Roosevelt's Square Deal to the Democratic Roosevelt's New Deal. He substantially changed the rules of the House of Representatives, sponsored legislation of lasting importance for agriculture and labor, fathered bills which created the Tennessee Valley Authority and the Twentieth Amendment to the Constitution, and was primarily responsible for the establishment in Nebraska of the only unicameral legislature in the United States.

As a political philosopher the Nebraskan was not profound. The sources of his political theory included the agrarian, equalitarian aspects of the Jefferson-Jackson heritage, the moralistic conceptions of the Social Gospel and Christian Socialism, and the Populist assumption that the enemies of society were the giant trusts and the Wall Street financiers. Norris comes closest to the philosophy of government epitomized by what Charles McCarthy, the Wisconsin Progressive, called the New Individualism.

The New Individualism, to Norris and other Midwestern Progressives, meant that the rule of the majority should be expressed by a strong government committed to a democratic vision of a broad social and economic program. The power of the state was to be used positively to promote social justice objectives and negatively to restrain unbridled laissez-faire capitalism. The Senator attacked capitalism, not in its essentials, but in its operation, and in its failure to measure up to how he thought it should operate. He wanted to keep capitalism, but at the same time control its evils. He wanted to eliminate the abuses of tariffs and railroad rates which oppressed the farmer, and the injunctions and court decisions which oppressed the laborer. Accordingly, he advocated regulation by commission, rigid taxing policies, and accepted the principle of public ownership and management in the area of natural monopolies and in fields where monopolies might exist to the public detriment.

Norris recognized the complementary nature of the farm and the city and worked with both the urban and rural aspects of the Progressive surge. He was a throwback to Populism and a link between the periods of reform as epitomized by the Progressive Movement and the New Deal. And when the reform spirit languished and was eclipsed after World War I the Senator nurtured it, and helped to revive it.

Although at times Norris fought a losing battle in an attempt to restore an age which was past, particularly in his acceptance of the agrarian myth; paradoxically his advocacy of the positive state kept him in the vanguard of the American reform tradition. He was a spokesman of the past but he held a vision of the future.

His philosophy of international relations stressed the

importance of moral justice and tended to be a combination of idealism and naiveté. He carried into his theories of world politics a confidence in the democratic processes of logic, reason, and law, and a humanistic belief in the brotherhood of man. But the Senator lacked a mature understanding of the intricacies of foreign affairs and the complex subtleties of power politics.

George W. Norris was an emotional liberal who had an abiding and passionate devotion to the concerns of his fellow men. His most lasting contribution was the expansion of the idea that the government owes a responsibility to all its citizens. Microfilm $4.15; Xerox $14.65. 323 pages.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

THE CHANGING STRATEGY OF BRITISH BASES

(Order No. Mic 61-1981)

DeWitt Clinton Armstrong, III, Ph.D.
Princeton University, 1960

In 1939, the British chain of strategic bases, stretching from London through Suez to Hong Kong, was regarded as the Life-Line of Empire. With that central chain, all British strategists confidently agreed, the world-wide base system impregnably underpinned Britain's status as a Great Power. Yet, a mere twenty years later, hardly a strategist's voice protested as the British Government decided to grant independence to Cyprus, the chief Mediterranean "fortress colony."

Investigating how so remarkable a change of influential opinion came about, the study uses a behavioral approach. The making of strategic policy is viewed as an activity of people whose choices depend in part on how they interpret what they see of the world around them. The people are those few Britons involved in choosing national strategies, who are some of the members of four occupational categories: political leaders, senior civil servants, armed service officers, and commentators. Group characteristics are examined, and the range of views on the value of bases is set forth, with emphasis on 1957-1959.

The source material included interviews and publications, the latter being the newspapers, weeklies, journals, and books to which many influential strategists were exposed, or where some wrote on defense policy. Besides the uncommon explicit evaluations, the more numerous oblique indications of attitude about bases were considered. Through interviews, forty British strategists gave opinion about their colleagues' ideas concerning bases, and also about the process of change in strategic thought. This vicarious contact with the realities of policy-making was invaluable as a partial corrective to the disembodied abstractions of library research.

Several conclusions about the strategists' characteristics help to explain why policy-response lagged behind events. British empiricism led the strategists to leave implicit their concepts of the national objectives and to deal only with details of execution, so that the impact upon these objectives when the strategic environment altered was apt to be overlooked. A pronounced British emphasis upon continuity and the lessons of history has likewise let many an implicit assumption about strategy survive unexamined beyond the end of its validity. The easy interchange of ideas among the homogeneous leadership group has been lessened, too, by the isolating effects of secrecy and specialization. Thus, in a rapidly transitional period, amid new dimensions of uncertainty, British strategy was influenced by these characteristics to be less anticipatory than reactive.

Conclusions about the content of strategic thought show the result. Thus, bases were devalued not because of inferences about nuclear weapons, or the East-West struggle, or the economics of defense, but because the Suez outcome in late 1956 meant the base-system had produced an unsatisfactory political result. Bases no longer sufficed to allow the national will to be enforced. Attendant events removing or restricting the British military presence in Ceylon, Cyprus, Jordan, and Libya made British strategists keenly conscious of local nationalism as a factor in strategy; those interviewed nearly all agreed that Britain would soon be pressured out of her remaining "fortress colonies" by the growing assertiveness of local populations.

To British strategists in 1959, bases still seemed valuable, not for the traditional sea power purposes, but to deter and wage limited war. Other forms of strategic deployment had risen to rival bases in the esteem of strategists: the air-lifted central strategic reserve, the "commando carrier," and naval forces sustained by "afloat support." The means of strategic nuclear deterrence made up the main budgetary competition, however, although everywhere but in Government policy the idea was growing that conventional forces needed to be expanded at the expense of these nuclear bombers and nuclear-tipped missiles. Microfilm $5.00; Xerox $17.55. 389 pages.

EQUALITY OF TREATMENT AND TRADE DISCRIMINATION IN INTERNATIONAL LAW: A STUDY.

(Order No. Mic 61-1406)

Khurshid Hasan, Ph.D.
Columbia University, 1961

The term discrimination, on inter-state level, is most frequently used in the field of commercial policies. In recent years, in particular, owing to a number of reasons – such as the trend towards regionalism, assumption by increasing number of states of functions formerly reserved to private individuals, and the needs of the under-developed countries in the early stages of industrialization – the problem of trade discrimination in the context of the principle of equality of treatment has been thrust into a sharp focus.

This study seeks to investigate the inter-relation between the principle of equality of treatment and trade discrimination in the framework of international law. Though the general principles of international law do not directly regulate commercial policies on the basis of the principle of equality of treatment, over the years, certain standards of equality of treatment have emerged in this field. Among

them, the most common and widely used is the most-favoured-nation standard, which seeks to ensure equality between states bound by the nexus of most-favoured-nation treaties and serves as a guarantee against discrimination. This standard is pre-eminently an optional standard of international law which is brought into operation by means of bilateral or multilateral treaties. However, with the signing of the General Agreement on Tariffs and Trade by almost forty states, the unconditional most-favoured-nation clause has become the guiding rule of commercial policy among the great majority of commercial states of the world. The Agreement, for the first time, attempts to define, as precisely as possible, the scope of the most-favoured-nation clause on the basis of which distinction can be made between legal and illegal discrimination. Insofar as it prescribes equality of treatment with regard to the import of goods, internal taxation, and all laws and regulations affecting internal sale and purchase of goods, and with regard to freedom of transit, discrimination in these fields, between contracting parties to the GATT, becomes illegal. Similarly, with regard to quantitative restrictions and transactions of State trading agencies, it seeks to outlaw discrimination by making the rule of non-discrimination the guiding rule.

Side by side with outlawing discrimination, the General Agreement also legalizes certain forms of discrimination. In doing so it takes note of the difference in the levels of economic development of the contracting parties, variations in the nature and structure of their economies and makes allowance for the changing needs and other exceptional circumstances which may make it necessary to depart from the principle of equality of treatment. Permissive discrimination in the GATT takes the form of exceptions to the most-favoured-nation principle in favour of existing preferential arrangements, customs unions, free trade areas, and interim agreements leading to the formation of either of them. Discrimination is also permitted on grounds of balance of payments difficulties, in the interest of economic development programmes, for reasons of national security, and to enforce sanitary regulations. In each case, in order to forestall the possibility of arbitrary abuse of the exceptions, permission to discriminate is made subject to the fulfillment of carefully prescribed conditions. Should a contracting party fail to meet the conditions, it would be deemed to have committed a breach of the Agreement and would be open to retaliatory measures by other contracting parties. In addition to the enumerated exceptions, the Agreement endows the Contracting Parties with authority to waive the obligation of a contracting party, if, in their judgment, the exceptional nature of the circumstances justifies such a waiver. Thus within the framework of the GATT, the principle of equality of treatment is a legal right, the denial of which can be a cause of complaint and call for remedial action on the part of the Contracting Parties.

The examination of the provisions of the GATT makes it quite clear that the principle of equality of treatment is not an absolute rule, even among the contracting parties. From the point of view of international law, moreover, since the operation of the principle is limited to the contracting parties only, discrimination vis-a-vis non-contracting parties is bound to continue. The possibility of the most-favoured-nation clause becoming a rule of customary international law is foreclosed by the ineffectiveness of the clause in ensuring equality of opportunity in trade between countries with centrally planned economies and free market economies because of the basic difference in their structure. Therefore, trade discrimination on the basis of the principle of equality of treatment in international law can only be regulated by means of bilateral or multilateral agreements, based on reciprocity, and it cannot be inferred from the general principle of equality of states in international law that a state is legally obliged to treat all third states alike in matters of tariffs and trade. Microfilm $4.40; Xerox $15.55. 341 pages.

A LEAGUE OF MINDS: THE INTERNATIONAL INTELLECTUAL COOPERATION ORGANIZATION OF THE LEAGUE OF NATIONS.

(Order No. Mic 61-1993)

Jan Kolasa, Ph.D.
Princeton University, 1960

Interest in the problems of cultural cooperation between different nations, and groups of nations, has been rapidly increasing in the present world of conflicting ideologies. On the one hand, politics has been transgressing its exclusively political boundaries and, on the other, intellectuals in the broadest sense of the word have become ever more involved with political considerations. Both politicians and intellectuals, it would seem, meet in the effort to intensify international intellectual contacts as a possible, if not ultimate, foundation for the peaceful cooperation of different nations and various civilizations.

The aim of this research is the examination of one period in the history of the evolution of international intellectual cooperation. It is devoted to the study of the International Intellectual Cooperation Organization established under the auspices and working under the direct surveillance of the League of Nations. Attention is focused on the organizational and philosophical aspects of the Organization as contrasted with efforts before 1921 and the extent of the influence of it upon the structure of UNESCO. A large part of the work deals with the Organization in practice, and provides a case study in the three large areas of international cooperation: 1/ activities concerned with the revision of school textbooks; 2/ the functioning of the International Studies Conference; and 3/ the action called Moral Disarmament.

From the organizational point of view the International Intellectual Cooperation Organization, like its paternal institution, the League of Nations, presents a revolutionary break with the past. It appears as the first potentially world-wide coordinating body with its own machinery and regular meetings, and with the ambition to embrace the whole scope of intellectual cooperation and all mankind.

The theoretical assumptions of the International Intellectual Cooperation Organization were those of Western civilization in general, and of liberal democracy in particular: faith in man as such, belief in his capacity and natural goodwill for cooperation with all others, and an almost unlimited faith in the power of education. Its ends evolved around the building of the intellectual foundation of peace by means of the intellectual reunifaction of a politically disintegrated world. It was mainly an intellectual

movement aimed at the building of the League of Minds among the most prominent intellectuals from different countries scattered all over the world. Paralleling this effort, attention was given to the formation of a broad base of public opinion; this action, however, seemed to remain, due mostly to practical reasons and possibilities, on the secondary plane. The whole movement may be regarded as a last cultural crusade of politically humiliated Europe.

The examination of practice reveals the development of rich and flexibly practical methods for building international intellectual cooperation on three different levels: 1/ elementary and secondary education; 2/ scholarly research; and 3/ the formation of a broad public opinion.

In contrast to the truly novel and pioneer character of the International Intellectual Cooperation Organization, UNESCO presents simply a continuation and an organic and logical evolution of both the organizational structure and ideological foundations of its forerunner. The official reluctance of the spokesmen for UNESCO to recognize publicaly the heritage from the International Intellectual Cooperation Organization is explained by their desire to disassociate themselves from the failure of the League of Nations. Microfilm $4.95; Xerox $17.35. 385 pages.

POLITICAL SCIENCE, PUBLIC ADMINISTRATION

FINANCIAL REPORTING AS A MEANS OF COMMUNICATION IN A PUBLIC JURISDICTION

(Order No. Mic 61-2535)

Aziz Nabavi, D.P.A.
University of Southern California, 1961

Chairman: Professor Shirley

This study was undertaken to expand the existing knowledge about the role and significance of financial information in administration of public agencies. At present, the accounting reports are considered by many administrators as mere records of receipts and disbursements—just a list of figures showing the "past" operations—to be filed in the archives or used occasionally to check the honesty of the men in charge. The majority of the public officials, including a good number of accountants, are almost entirely unaware of the importance of the accounting data in the life of the organizations where they belong. In the academic world, too, the concept of financial reporting as a means of communication is unexplored. There is a large body of literature in organization theory, decision-making, communication and control, or in accounting and financial administration; but there is little, if any, to deal directly with the present subject. This study is the first investigation directly related to the communicative aspects of financial reporting in public administration.

In the conduct of the study an extensive use was made of the literature in the related fields to build a frame of reference for the empirical research. Characteristics of the financial information flow in the City of Beverly Hills, California, were examined as a case study. In addition to the questionnaires, interviews, and personal observations employed in the process of the survey, certain new devices were designed to find out the patterns of communication and to illustrate the results. The use of the communimetric matrix and communigram, for example, was introduced to the study of organization and management for the first time.

Findings. (1) Financial information is communicated throughout the organization by communication media, ranging from the formal regular published reports to informal face-to-face contacts during a social gathering. (2) A great deal of the information flow takes place through formal periodic reports—especially the Budget Document, Monthly Statements, and the Annual Report—and through telephone calls. (3) Accounting information is used both as a guide for operations of the organization and as a tool for implementation of the programs. The most important functions accomplished by the financial information are directing the attention of the city officials to many issues and problems, serving as an important means of control, and providing the factual information basic to the organizational decision-making. (4) Accounting information serves a homeostatic function in maintaining organization equilibrium. (5) City officials use financial information in their decisions to a varying degree. Accounting data are used as a basis for decision-making more in the upper levels of the hierarchy than in the lower ones. (6) The communication of financial information in the city does not entirely correspond with existing theoretical concepts of administrative communication: for example, (a) the communication overlay is mainly bidimensional—vertical and horizontal—rather than multidimensional and crosswise; (b) there is no serious noise entropy affecting the information flow adversely; and (c) the feedback mechanism existing in the communication of the accounting data is quite different from that of other communication systems.

Conclusions. The findings of the study evidenced that financial information is a significant part of the communication system in the city and it possesses certain characteristics. However, studying the practice in only one public jurisdiction cannot typify the practice in all or a majority of similar organizations. For this reason, the aim of the present research was not to construct a clear-cut theory or a so-called principle. This investigation has been only an initial effort and naturally exploratory and experimental in nature. The above findings should serve as a series of hypotheses to be tested and verified in the future in other public jurisdictions.

Microfilm $3.00; Xerox $10.35. 229 pages.

CITIZEN GROUP ACTIVITY IN THE DELAWARE RIVER BASIN

(Order No. Mic 61-1499)

Donato Joseph Pugliese, D.P.A.
Syracuse University, 1960

Supervisor: Frank J. Munger

As a result of a flood caused by the sweeping rains of hurricane Diane in August of 1955, the District Engineer of the United States Army Corps of Engineers was directed by his superiors and by later resolutions of the United States Congress to conduct a comprehensive survey of the Delaware River Basin--the first such survey of the Delaware, or any other eastern, river basin. Since the experience with similar surveys in other basins indicates that organized citizen activity plays an important role in the success or failure of recommended comprehensive plans, there is no reason to draw a contrary assumption concerning the role of such groups in the Delaware River Basin. Thus, this study is basically concerned with the problem of designating those organizations in the Delaware River Basin which might play an important role in the acceptance or non-acceptance of the comprehensive plan presented to Congress by the Corps of Engineers.

Citizen group activity in the Delaware River Basin is described through an analysis of eighteen past issues relating to water and water resources. A description of the characteristics of citizen groups in the basin is presented on the basis of the information provided by 206 organizations responding to a questionnaire mailed to them in the course of this study. By utilizing the materials developed in the case studies and in the evaluation of the questionnaires, three categories of organizations were developed.

Category III includes those organizations deemed to be the least important or unimportant. Category II includes those organizations which are important in a limited or special way, but cannot be designated as the most important organizations. Category I includes the organizations deemed to be the most important to the success or failure of a comprehensive development plan of the water resources of the Delaware River Basin.

The organizations designated as important rank at the top of all or almost all of the eleven criteria used to evaluate their importance and in some cases were on the winning side of several of the case studies. All but two of the important organizations also ranked in the top half of a list of thirty-one organizations rated by eighteen experts.

Thirteen organizations are considered to be the important organizations in the Delaware River Basin. They are:

Brandywine Valley Association
Chamber of Commerce of Greater Philadelphia
Delaware State Chamber of Commerce
Delaware Valley Council
Delaware Valley Protective Association
Garden Club Federation of Pennsylvania
Joint Executive Committee for the Improvement and Development of the Philadelphia Port Area
League of Women Voters of New Jersey
Lehigh Valley Flood Control Council
Neshaminy Valley Watershed Association
New Jersey Farm Bureau
Pennsylvania Federation of Sportsmen's Clubs
Pennsylvania State Fish and Game Protective Association

A further check on the validity of this list was made by having a group of expert raters judge the importance of thirty-one organizations, including the thirteen listed as important by this study. The results of the rating procedure were in general agreement with the results of the methods used in this study. Actually, each of the three techniques, rather than conflicting with one another, added additional names or details as to the rankings of the organizations under analysis.

In the final analysis, the validity of this conclusion will be tested in the legislative arenas of the four states and the nation where the actions necessary to adopt and implement the Corps of Engineers' comprehensive plan must be taken. It will be in that conflict that the important organizations can be finally designated.

Microfilm $4.30; Xerox $15.10. 333 pages.

PLANNING FOR INDUSTRIAL DEVELOPMENT: WITH EMPHASIS ON THE METROPOLITAN AREA.

(Order No. Mic 61-1504)

Clyde Joye Wingfield, D.P.A.
Syracuse University, 1960

Supervisor: Jesse Berkhead

This is an era of metropolitan reshuffling in America. Industrial dynamics represent such an integral part of this pattern of urban rearrangement that those who plan for industry, whether consciously or not, plan the future course of urbanization. It is from this premise, identifying industrial development as an essential causal factor in urban dynamics, that the urban planner must move.

Yet, there is a reluctance on the part of the public sector to assume responsibility for industrial planning. Traditionally such action has been viewed as strictly a private function. And while it is axiomatic that the growth of industry is of special concern to the progressive community, it is equally certain that in the view of the conventional wisdom the planning and promotion of industry belongs to the private sector.

Reviewing the literature, it quickly becomes evident that there are two quite different perspectives where industrial location and industrial land use are concerned. The public perspective is, or should be, concerned with the implications a new industry will have for the community. How will it benefit the community? What will it cost? Conversely, the private sector has reason to be primarily interested in maximizing returns from investment. These two positions seldom coincide.

From the literature of the two sides it is possible to identify techniques and knowledge with apparent dual application and meaning. But due to the parochialism of professional and disciplinary outlook cross-fertilization has been largely avoided in the literature and in practice.

This work deliberately identifies with the purposes of the public planner. However, recognizing that most planning for industry today is done by the private sector there must be some effort to understand this process and

integrate and synthesize the methods and techniques of both.

From classical location theory and later developed applied techniques of analysis it is possible to describe how urbanization evolved and the part industrialization played in the urban arrangement. Input-output analysis and economic base estimates suggest a basis for projecting growth trends into the future and thus predicting, or at least speculating, about the future pattern of urban growth or decline. This body of knowledge and insight has too often been ignored by the public planner. The literature dealing with industrial location determinants has equal utility in the public sector where there is conscious recruitment of industry.

Outside the traditional body of location theory, but nonetheless significant to locational decisions is a broad variety of factors relating to metropolitan characteristics as opposed to the usual economic factors of market, raw materials, labor, tax rates, transportation, etc. The political, social and economic characteristics of the metropolis so influence industrial location practice that often it is difficult to separate cause from effect.

Public planning for industry has not generated much in the way of literature or theory. However, there are some useful weapons available in the public arsenal. Zoning poses as one of the earliest and most widely accepted. But for modern deployment the city must turn to more updated weapons. The comprehensive industrial development plan and the techniques of land use planning offer some hope in this respect.

In the final analysis it may be concluded that there is a politico-economic paradox in the basic American ideology. The entrepreneur concept in the classic model of capitalism stands at poles with that character of public planning which by definition would restrict, or worse, deny private actions seeking profits. If the public sector is to control the future design of urban growth it is essential that some device be found to serve as an ameliorative mechanism for the poles of the paradox. One such concept stems from the experience of the industrial development corporation in the United States. In the most conservative parts of the South and New England there can be found a good deal of data to document the acceptance of this device as a planning and promotional instrument. The implications for wider adoption became clear upon examination.

In concept the industrial development corporation is a governmentally endorsed or sponsored corporation financed in part by private subscription and geared to public policies affecting industrial development.

Microfilm $3.35; Xerox $11.70. 257 pages.

PSYCHOLOGY

PSYCHOLOGY, GENERAL

SOME PSYCHOLOGICAL ASPECTS OF MOTION PICTURE MONTAGE

(Order No. Mic 61-1618)

John Robert Gregory, Ph.D.
University of Illinois, 1961

The conventions of motion picture montage (editing) have been compared to the grammar of a language. In this paper the relationship is made specific by an analogy with modern English. Analogies are drawn between the four types of cues in the signal system of English grammar -- word order, structure words, grouping of words, and inflection -- and motion picture phenomena. Analogies are then drawn between the three cinematic techniques of production -- direction, cinematography, and editing -- and speech formation. A psycholinguistic theory is proposed to explain the dynamics of the cognitive interaction occurring when two (or more) motion picture shots are placed in succession, showing how this fundamental process of motion picture montage can make an assertation. Assertions, together with the emotional context in which they are made, will exert some control over the relationships between characters as perceived by an audience. These three aspects of motion picture montage -- assertions, emotion control, control of relationships -- are studied in an experimental situation.

Three differing short films were edited from identical groups of live-action film scenes. Similar film-clips were edited from abstract (animated) film scenes. Six groups of subjects were shown one film each, immediately after which they completed printed test forms which included check-off lists of assertions, questions on relationships of characters, and semantic differentials. Data from these tests are presented and discussed. Evidence indicates that the assertion structure is valid (i.e. communicates). Emotion control and relationship structures are somewhat less predictably effective, at least in the short time duration of the test situation.

Microfilm $2.75; Xerox $6.60. 138 pages.

SELF-ACCEPTANCE IN RELATION TO ADJUSTMENT

(Order No. Mic 61-2240)

Doris Cahoon Perry, Ed.D.
The University of Florida, 1961

This study is concerned with the theoretical position found in Rogers' Client-Centered Therapy and Combs' and Snygg's Individual Behavior that the individual's perceiving structure under threat denies or distorts perceptions of objective reality. These theorists pose further that the well adjusted individual has no need to employ this means of perceptual defense, but modifies his self-structure to include the threatening perception. The major purpose of this study was to examine this perceptual process of

defense by submitting to a group of well adjusted individuals and a group of maladjusted individuals a list of self-damaging statements to deny or to admit as true of self. If the above theoretical assumptions are valid, the results of such an administration should support the hypothesis that the well adjusted individuals would admit to a significantly greater number of self-damaging statements than would the maladjusted.

Experimental Design

The design of this study was based on a study conducted in 1951 at Syracuse University by Taylor and Combs. These investigators compiled a list of twenty statements damaging self if admitted, which they felt to be generally characteristic of the behavior of sixth-grade children. They submitted these statements to groups of well adjusted and maladjusted sixth-graders and found that the well adjusted admitted to a greater number of statements than did the maladjusted children. This study was criticized by the experimenters themselves for the circularity of the design, as they used the California Test of Personality to determine adjustment and this test contained self-damaging statements. Furthermore, they failed to report their statistical procedures.

The purpose of the present study was to redesign the Taylor-Combs study by establishing more valid criteria for the selection of the well adjusted and maladjusted groups, and by enlarging and refining the statistical procedures for analyzing the results, while administering the same list of self-damaging statements.

Subjects

The sixty-three subjects participating in this experiment were fourth-grade white boys of average intelligence attending the public schools in the low socio-economic area of Atlanta, Georgia. The thirty-one well adjusted children were selected by means of the judgments of the teachers and principals of the children, with a check list of behavioral attributes submitted by the examiners as a guide to selection. The thirty-two maladjusted children were diagnosed as such by five clinicians of the Psychological Clinic operating within the Department of Pupil Personnel Services of the Atlanta Board of Education. The diagnoses of these maladjusted subjects were made from the Rorschach Psychodiagnostic Test, The Bender-Gestalt Motor Visual Test, and the Revised Stanford-Binet Form L Intelligence Test.

Results

The results of the study revealed a mean difference of 1.95 admissions to self-damaging statements between the two groups. The well adjusted group admitted to a total of 205 statements and the maladjusted group admitted to a total of 149 statements. The difference was significant at a .025 level as computed by Guilford's Student "t." The reliability of the experimental instrument was computed by a Pearson Product-Moment correlation by the test-retest method of administration with an interval of six weeks. A reliability coefficient of .084 was established. This is significant beyond the .01 level.

Conclusions

The statistical analysis supported the hypothesis of the study, showing that the well adjusted group admitted to a significantly greater number of self-damaging statements than did the maladjusted group. On the basis of these data, it is reasonable to assume that the theoretical assumptions underlying the hypothesis are valid. The conclusion was drawn that denial of self-damaging statements occurs with sufficient frequency in groups of maladjusted persons to support the theoretical position.

Microfilm $2.75; Xerox $4.60. 90 pages.

THE EFFECTS OF EPINEPHRINE, CHLORPROMAZINE, AND DIBENZYLINE UPON THE FRIGHT RESPONSES OF RATS UNDER STRESS AND NON-STRESS CONDITIONS.

(Order No. Mic 61-2158)

Jerome Everett Singer, Ph.D.
University of Minnesota, 1961

Adviser: Stanley Schachter

As a result of previous experiments, Schachter et al. have advanced the hypothesis that an emotion is the joint function of an appropriate cognition and a state of arousal of the sympathetic nervous system. In the experiments which have been conducted to test this hypothesis, sympathetic arousal was manipulated by injecting subjects with either adrenalin, a sympathomimetic drug, chlorpromazine, an adrenergic blocking drug, or a placebo. Although the results of the experiments were positive, the exact nature of the linkage between sympathetic activation and emotion seems equivocal. In order to explicate this relationship efficiently, it was tested in a study upon rats.

The autonomic activation of the rats was controlled by injections of drugs. The rats were randomly divided into three groups each of which received a different drug:

a) an injection of epinephrine hydrochloride (adrenalin)--a sympathomimetic agent

b) an injection of a placebo

c) an injection of chlorpromazine hydrochloride--an adrenergic blocking agent

The three were assumed to have three different levels of sympathetic arousal; chlorpromizine the lowest, epinephrine the highest.

All of the animals within each drug condition were placed one at a time into an experimental chamber. They were left there for a standard amount of time and their responses coded on a standard observation form. Half of the rats in each drug group while in the experimental box were subjected to stimuli which are normally stress producing: flashing lights, sounding buzzers, and ringing bells. There were then a total of six experimental conditions which can be schematized as follows:

Exposed to stress stimuli	Epinephrine injected	Placebo injected	Chlorpromazine injected
Not exposed to stress stimuli	Epinephrine injected	Placebo injected	Chlorpromazine injected

The responses of the rats were analyzed with respect to the amount of fright manifested. It was predicted and found that in the non-stress stimuli conditions, there was no differential fright among the various drug groups. In the stress stimuli condition, it was predicted and found that the amount of fright exhibited was directly proportional to the rats' level of sympathetic activation with the epinephrine rats most frightened, the chlorpromazine rats least frightened, and the placebo rats at an intermediate level.

Dibenzyline was used as an alternative adrenergic blocker, and it was predicted, that as with chlorpromazine, rats injected with it would have a low level of sympathetic arousal and, hence, a low level of fright. The results of the dibenzyline condition were inconclusive.

Microfilm $2.75; Xerox $4.00. 72 pages.

PSYCHOLOGY, CLINICAL

ATTITUDES AND PERSONALITY CHARACTERISTICS OF MOTHERS AND THEIR RELATION TO INFANTILE COLIC

(Order No. Mic 61-2311)

Mortimer Brown, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor Warren W. Webb

This study was conceived as a result of a convergence of the developmental and clinical points of view in contemporary psychology within the framework of the principles of general psychology.

Modern personality theories and recent research point up the importance of the relationship between the child and the parent. It was formerly believed that deviant child behavior was related specifically to particular training procedures or other child-adult experiences. It is now known that this is not in the form of a point to point relationship.

The current work was undertaken to explore the role of a wide range of maternal attitudes toward child rearing and personality characteristics of mothers and the relationship between these factors and infantile colic. It was found that a constellation of personality-attitude factors exists with anxiety as a major underlying motivational factor which discriminates between groups of mothers producing colicky infants and groups of mothers of non-colicky infants. The tests do not predict individual cases. Mothers of colicky infants are more likely to present the following characteristics: (1) anxiety, (2) low sense of well being, (3) low capability of presenting a good impression, (4) feel strongly about the need for breaking the will of children, (5) feel negatively about encouraging verbalization in children, (6) low degree of self-control, and (7) more likely to have attended classes for expectant parents.

The findings are interpreted in a bio-psychological theoretical framework and extend the range of information in this area.

Implications for further research were discussed.

Microfilm $2.75; Xerox $3.60. 61 pages.

PERSONALITY CORRELATES OF PICTURE PREFERENCES

(Order No. Mic 61-2465)

George Cerbus, Ph.D.
Purdue University, 1961

Major Professor: Robert C. Nichols

The use of aesthetic preferences as measures of personality combines the subtlety of projective tests with the adaptability to statistical treatment of the personality questionnaire. The general purpose of this study was to explore the potentialities of this technique of personality assessment. Specific variables chosen for investigation were the achromatic-chromatic qualities of pictures, the representational or concrete versus abstract qualities, and the depicting of non-human objects or things in contrast to people.

One hundred slides of a wide variety of artistic productions were chosen from a file of 10,000 slides in the Art Design Department of Purdue University. Each picture was judged individually by the experimenter on the three variables, as well as being rated individually by a group of 25 student judges for general aesthetic preference. Pictures of equivalent aesthetic preference were paired with opposing characteristics on one variable and common characteristics on the remaining variables. Preliminary scales, each of 58 items, were constructed and tested for internal consistency on a sample of 106 hospital patients and aides, and on a sample of 118 college students. The purified scales were correlated with scales of the California Personality Inventory in the college sample, with scales of the Minnesota Multiphasic Personality Inventory in the hospital sample, and with therapists' ratings on the Multidimensional scale for Rating Psychiatric Patients of a supplementary sample of 51 patients.

A 27-item scale of the preference for achromatic versus chromatic pictures was found to have reliability in the .70's, as estimated by Kuder-Richardson formulas. It was not significantly related to the Concrete-Abstract scale (correlation of .11 in the total sample), but was found to be significantly related to the Things-People scale in a curvilinear manner (correlation ratio of .35). Significant correlations with personality measures were limited to those with the Hypochondriasis (.35) and Hysteria (.20) scales of the MMPI, but are considered to be chance results in view of the contradictory findings with the therapists' ratings and the failure of no more than two of 63 correlations with other personality measures to attain significance.

A 38-item scale of the preference for concrete versus abstract qualities in pictures was found to have Kuder-Richardson estimates of reliability of approximately .90. The correlation of it with the Things-People scale was low

but significant (.14 with 224 subjects). Significant correlations with other personality measures consisted of the correlations with F (-.28), Masculinity-femininity (-.23), and Schizophrenia (-.24) scales of the MMPI and with ratings of the presence of impulses to commit a criminal or hostile act (point-biserial correlation of -.34). Significant differences were also found between Concrete-Abstract scores of neurotics and psychotics, as well as between hospitalized patients and college students. As such, it appears to be related to the more conforming and traditional behavior and to increased use of repressive defenses, but such results are considered only tentative in view of only four out of the 63 correlations with other personality measures attaining significance.

A 39-item scale measuring preferences for pictures of things versus pictures of people had reliability estimates in the .70's. The 16 significant correlations of this scale with the 63 personality measures greatly exceeds chance findings. CPI scales of Dominance (-.24), Capacity for Status (-.22), Social Presence (-.22), Self-acceptance (-.23), and Socialization (.21), and MMPI scales of Depression (.20) and Masculinity-femininity (-.23) were significantly correlated with this scale, as well as ratings of withdrawal of interest and self-depreciation. Such results indicate that this is a measure of general interest in people, as suggested by the picture content. More promising results with this scale suggests further investigation of picture preferences incorporating content instead of the structural qualities of the pictures.

Microfilm $2.75; Xerox $5.00. 96 pages.

THE EFFECTS OF TWO CONTRADICTORY LEVELS OF REWARD AND CENSURE ON SCHIZOPHRENICS

(Order No. Mic 61-2278)

Paul Vincent Ciotola, Ph.D.
University of Missouri, 1961

Supervisor: Dr. Kenneth B. Brown

An attempt was made to test one aspect of the double bind hypothesis as presented by the Bateson group. An experimental situation was devised according to principles concerning the double bind as set forth by the above theorists. The general hypothesis was that schizophrenics would be more affected by the double bind than nonpsychotics in terms of increased RT's, more concreteness and increased tension. Schizophrenics and nonpsychotics were used in the experimental situations and in control situations. Length of hospitalization was also used as an independent variable.

The results failed to support the hypothesis. The double bind situation produced no measured differential inhibitory effects on the behavior of schizophrenics as related to the experimental predictions. Several significant differences were found between long and short-term hospitalized patients and between types of treatment groups, regardless of diagnosis. A possible facilitory effect of the double bind for long-term patients was discussed in terms of the "set" approach formulated by Cavanaugh and Lang.

The limitations and possible criticisms of the study are discussed, and several new measures and alternative methods of producing the double bind are indicated.

Microfilm $2.75; Xerox $3.80. 66 pages.

THE PSYCHOGRAMMATICAL HOMOGRAPH TEST: AN INVESTIGATION OF CERTAIN ASPECTS OF GRAMMATICAL USAGE IN RELATION TO CERTAIN ASPECTS OF PERSONALITY.

(Order No. Mic 60-4433)

Robert Jay Decker, Ed.D.
Temple University, 1960

The purposes of this study were to explore the possibilities of constructing a reliable psychogrammatical scaling instrument and of investigating possible relationships between psychogrammatical and other behavioral traits. Two hypotheses were tested: (1) that individuals responding to grammatically ambiguous verbal stimuli (i.e. homographs capable of use as nouns, verbs, and adjectives) may be reliably scaled in accord with their psychogrammatical response preferences; and (2) that individual variation in psychogrammatical response preferences, as determined by a standardized homograph test, is related to other forms of behavioral variation.

The need for this research is indicated in the literature. It appears that previous studies have been unable conclusively to demonstrate a relationship between psychogrammatical and other meaningful behavioral traits, and that certain experimental difficulties confronting the psychogrammatical investigator have been inadequately dealt with.

To illustrate: a psychogrammatical study typically involves (1) the collection of a set of speech samples; (2) a frequency count of subjects' usages of one or more selected grammatical variables; (3) the correlation of subjects' grammatical "scores" with some external criterion. In the past, problems pertaining to the grammatical unit of analysis have often been inadequately faced. Identification of the unit of analysis has not always been demonstrated to be consistent among coders. Labeled units of analysis have not been shown to have similar significances among subjects. Consideration of the reliabilities of subjects' grammatical "scores" has often been lacking. Also, problems in connection with control of the stimulus situation have often not been faced. Differing stimuli (e.g., different "thematic" pictures or theme assignments) can effect psychogrammatical differences among differing groups and individuals, and speech samples derived in response to such differing stimuli may not always be lumped together, whether for immediate statistical treatment or for ultimate interpretive ends. In some experiments the method of stimulus presentation has not been designed to prevent subtly biased results. In addition, certain variable individual response tendencies (e.g., verbal fluency) and related characteristics (e.g., intelligence and/or sex) have often not been properly considered in the previous psychogrammatical experiments.

The present study specially deals with the construction of a standardized homograph test; an analysis of the psychogrammatical response behavior of the "standardization" groups; a cross-validational study; and the final experiment,

concerned with demonstrating the relationships between psychogrammatical and other behavioral traits.

The procedure was as follows. A list of 45 homographs -- that is, words capable of use in a sentence as nouns, verbs, or adjectives, respectively -- which had survived certain pretesting requirements was administered to 82 male and 94 female college students. A statistical item analysis, involving a weighted response system, and a differential analysis of the groups' psychogrammatical responses were made. The item analysis disclosed that with a discard of three homographs for use by males and seven homographs for use by females, six fairly reliable psychogrammatical scales -- a noun, verb, and adjective scale for each sex group, with an average coefficient of internal reliability of .68 -- could be obtained. The major finding of the differential analysis was a marked difference in the psychogrammatical response tendencies of the sex groups: males preferred significantly more noun usages and significantly fewer adjective usages than did females (while the groups were essentially alike in their preferences for verb usages).

In the next step of the study, the reduced list of 43 homographs, embodying one "buffer" item (i.e., a homograph to be responded to but not scored) for males and five buffer items for females, was administered to new subject groups (94 male and 94 female college students). An analysis of the data disclosed that these groups had responded very much as had the standardization groups. No significant differences were found with respect to the corresponding internal reliabilities and intercorrelations of the psychogrammatical scales, nor with respect to the corresponding means and standard deviations of the psychogrammatical arrays (whether weighted or unweighted). As with the standardization groups, none of the arrays of the experimental groups differed significantly from a normal distribution. The individual homographs proved to be highly stable, in terms of their psychogrammatical response proportions, across the groups.

In the final step of the study, the various psychogrammatical scores (including three quotient scores) of the experimental groups were correlated with scores attained by the same subjects on the Guilford-Zimmerman Temperament Survey and also with their scores on the Temple English Test and on the Ohio State University Psychological Test.

The results of the correlational analysis for the female group indicated no reliably significant relationships between the psychogrammatical and Guilford-Zimmerman scores. However, a significant negative relationship was demonstrated between the adjective scores and scores on the Temple English Test. (The corresponding relationship was "appreciable" and positive in connection with the verb scores.)

With respect to the male group, the results of the psychogrammatical-Guilford-Zimmerman trait correlational analysis disclosed a number of significant low-magnitude relationships in excess of chance expectancies. However, the outstanding finding with respect to the male group resulted from a special analysis of the relationships between five Guilford-Zimmerman trait scores and the verb and adjective scores, respectively. This analysis clearly revealed that "verbification" relates negatively, and that "adjectivalization" relates positively, to an apparent common factor underlying traits G ("energy"), "reversed" R ("spontaneity"), A ("ascendance"), S ("sociability"), and E ("emotional stability"). This factor was interpreted by the investigator to be a broad bi-polar dimension of personality somewhat analogous to introversion-extroversion and was labeled "positivity-negativity." Verbification seemingly relates to a broadly "negative" personality structure, and adjectivalization to a broadly "positive" personality structure.

With respect to the relationships in the male group between the psychogrammatical and "intellectual" measures, none of a significant magnitude was found. (There is a suggestion, from the consistent patterning of the relationships, that noun usages may be found to correlate positively, and verb usages negatively, with functioning intelligence.)

These results, of course, should be considered in the light of certain limitations of the study. For example, the subject groups were not necessarily representative of all college students. The list of homographs was not necessarily a representative list and it differed in number of items and in item-significances for the sex groups. The psychogrammatical category labels used in the present study may not have the same significances as identical labels used in other situations. The reliabilities of the psychogrammatical scales were not ideally high. Also, there are certain weaknesses inherent in the nature of a questionnaire-type of personality inventory.

But the implications of the present findings are fairly clear. There is a need, first of all, for a refined version of the homograph test. Such a test may reasonably be expected to measure individual psychogrammatical variation with greater precision than the present test and may ultimately disclose important diagnostic, prognostic, evaluative, and selective applications. Certain resemblances between the present psychogrammatical correlates and posited Rorschach correlates suggest that systematic investigation of the area of overlap between psychogrammatical and Rorschach variables may prove to be of theoretical as well as practical worth. The results of the present study suggest that sex differences may also require control in the conventional psychogrammatical experiment. Finally, there is a need indicated for studies which would clarify the relationships between the psychogrammatical categories used in the homograph experiment and conventional categories.

In the light of the evidence presented at this time, it is concluded (1) that individuals responding to grammatically ambiguous verbal stimuli may be reliably scaled in accord with their grammatical response preferences; and (2) that individual variation in psychogrammatical response preferences, as determined by a standardized homograph test, is related to other forms of behavioral variation. It is further concluded that a refined version of the homograph test offers to be of promise for psychology.

Microfilm $2.75; Xerox $5.60. 111 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

VERBAL CONDITIONING IN SCHIZOPHRENIA AS A FUNCTION OF DEGREE OF SOCIAL INTERACTION

(Order No. Mic 61-2468)

Eugene Ebner, Ph.D.
Purdue University, 1961

Major Professor: John M. Hadley

Recent studies of motivational processes in schizophrenia using techniques of verbal operant conditioning have found that schizophrenic subjects exhibit little responsiveness to positive verbal reinforcement as compared to normal subjects. These results have been interpreted as demonstrating an extinction of responsiveness to acquired social rewards in schizophrenic subjects. Consideration, however, of the tendency of the schizophrenic individual to withdraw from social interaction suggests that the necessity of interacting with another person in the verbal conditioning procedure may produce inhibition of the response tendency. The present study was an attempt to determine whether reducing the degree of social interaction involved in a verbal reinforcement situation would lead to greater responsiveness to social rewards (reinforcement). It was hypothesized that a group of schizophrenic subjects would show greater conditioning to verbal reinforcement in a situation requiring minimal social interaction than a comparable group responding in a condition necessitating a greater degree of interaction. A secondary aim of the study was to investigate the variables of anxiety level and chronicity of illness in relation to the verbal conditioning data.

The procedure consisted of having subjects make up sentences when presented with a series of cards with five pronouns and a different verb printed on each card. All sentences including I or We were reinforced by the statement "Good." In one experimental condition the reinforcement was spoken by the experimenter who was in the direct presence of the subject throughout the task. In another condition, the experimenter was hidden from the subject and the reinforcing statement was tape recorded and delivered through a loudspeaker. Following the conditioning task, all subjects were questioned concerning their awareness of the nature of the experiment and were given the Taylor Manifest Anxiety Scale. Case history data were gathered for the schizophrenic subjects and submitted to three clinical psychologists for rating of chronicity of illness on a five point scale devised for this purpose. Eighteen schizophrenic and eighteen normal subjects were tested in each experimental condition.

The verbal conditioning data were evaluated by analysis of variance techniques and revealed that:

(1) Significant conditioning effects were shown by the normal groups in both experimental conditions. Neither schizophrenic group demonstrated conditioning although there was a trend in this direction for the schizophrenic subjects responding under minimal interaction.

(2) No consistent relationships were found between anxiety level and amount of verbal conditioning for any of the experimental groups.

(3) A significant correlation existed between chronicity of illness and verbal conditioning in the schizophrenic interaction group such that the more chronic patients showed a higher level of conditioning.

(4) In the normal interaction group subjects who were aware of the reinforcing contingency showed significantly more conditioning than unaware subjects. No significant effects of awareness were found in the other experimental groups.

The results indicate that the experimental hypothesis was generally unsupported although the probability level of conditioning effects for the schizophrenic noninteraction group approached significance at the .05 level. This trend suggests that further experimentation in which the differences in amount of social interaction are more sharply separated might reveal more accurately the effect of social interaction upon conditioning. The minimal amount of conditioning observed in the schizophrenic subjects supported the hypothesis of lessened responsiveness to social rewards although it was suggested that further theorizing in this area might benefit from a more elaborated conceptualization of the reinforcement principle, with regard to the cognitive and affective meaning of the response class chosen for reinforcement. The present data failed to clarify the ambiguous findings concerning anxiety level and verbal conditioning and it was suggested that more specific measures of momentary anxiety might have greater applicability to this type of experimental situation.

Microfilm $2.75; Xerox $4.80. 94 pages.

DISTORTIONS IN THE PERCEPTION OF SELF AND OTHERS BY PERSONS USING PARANOID DEFENSES

(Order No. Mic 61-2316)

Philip Henry Havener, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor Carroll E. Izard

The purpose of this study was to measure the two defensive behavior patterns of unrealistic self-enhancement and projection in terms of distortions in the perception of self and others. Frenkel-Brunswik reported finding some subjects who gave self-reports which were judged by others as being unrealistic self-enhancement. Sears had similarly identified projection in the reports on self and others as given by several subjects.

Following the approach of Snygg and Combs and Rogers, several studies were concluded on various dimensions of the self-concept and of attitudes toward others. In general, it was found that self-satisfaction was positively related to adjustment and that persons who accepted themselves accepted others. However, some researchers began to find exceptions.

These exceptions indicated that some types of maladjusted persons, notably paranoid schizophrenics, tended to overrate themselves and underrate others. It was on the basis of these tentative findings that this investigation was planned. Since the defensive patterns under investigation are the ones attributed to persons displaying paranoid reactions, it was considered appropriate and economical to compare persons judged as displaying paranoid defenses with some who were judged as not being so. It was also planned to investigate the proposition that these defenses are normally distributed in a population of adjusted persons.

It was hypothesized that persons using paranoid defenses would demonstrate significantly more distortions in the perception of self and others than persons not using paranoid defenses.

A group of 20 hospitalized paranoid schizophrenics was selected on the basis of psychiatric diagnosis and a high score on the paranoid behavior factors of the Lorr Scale. A second group of hospitalized non-paranoid schizophrenics was selected on the basis of diagnosis and a low score on the same factors of the above scale. A group of 20 attendants at the same hospital formed the second control group. A group of 44 servicewomen and a group of 74 servicemen were used to measure the prevalence of the defense under study in a population of adjusted persons.

The Berger Scale which contains 36 items referring to self and 28 items referring to others was used to measure distortion in the perception of others. The Tennessee Department of Mental Health Self-Concept Scale was used to measure distortions in the perception of self. A paranoid-like behavior (PLB) Rating Scale was developed. to measure unrealistic self-enhancement and projection in the two groups of adjusted persons.

In general, the paranoid schizophrenics had significantly greater distortion in the perception of self and of others than did the two control groups. The distortion was in the direction of unrealistic self-enhancement and projection.

In the group of 44 servicewomen and the group of 74 servicemen, ratings by their officers on the PLB Rating Scale were correlated with the scores on the Berger Scale and the Self-Concept Scale. None of these correlations was significant.

The results of this study confirm previous findings on the difference in attitudes toward self and others for maladjusted persons as compared to adjusted persons. It was concluded that this study has given support to the proposition that persons who are diagnosed as using paranoid defenses demonstrate distortion in the perception of self and others in the direction of unrealistic self-enhancement and projection as measured by self-reports.

Microfilm $2.75; Xerox $6.20. 130 pages.

THE EFFECTS OF VERBAL AND NON-VERBAL REINFORCEMENT ON THE PERFORMANCE OF SCHIZOPHRENIC SUBJECTS

(Order No. Mic 61-2488)

Neil David Koppenhaver, Ph.D.
Purdue University, 1961

Major Professor: John M. Hadley

The present study was concerned with the performance of schizophrenic subjects on a visual-motor, paired-associate learning task, under conditions of verbal and non-verbal reinforcement designated as "reward" and "punishment." It was also characterized as an attempt to answer such questions as: Do the effects of verbal reinforcement differ from those of non-verbal reinforcement on the performance of schizophrenic subjects? Does verbal "reward" affect performance differently than verbal "punishment," and does non-verbal "reward" affect performance differently than non-verbal "punishment?" Are the effects of the reinforcement on performance, be it verbal or non-verbal, a function of the subjects' premorbid level of adjustment, or do the effects function independently of the premorbid adjustment?

The rationale for the study was derived from a survey of the literature which revealed that although several studies have been concerned with the differential effects of verbal "reward" and verbal "punishment," and that several authors have investigated the effects of verbal "reward" as compared with non-verbal "punishment" on the performance of schizophrenic subjects, there appeared to be lacking a study which would allow for a direct comparison between the effects of verbal and non-verbal reinforcement. Furthermore, the studies reporting differential effects of reinforcement on performance also suggested that such differences were a function of the subjects' premorbid level of adjustment.

The subjects used in the present study were male, psychiatric patients, all diagnosed as schizophrenic reaction, who were selected on the basis of rigid criteria. They were divided into four groups as a result of the scores they obtained on the Phillips Prognostic Rating Scale. This division produced two groups of "good" subjects and two groups of "poor" subjects. Each subject performed under one of the two, verbal or non-verbal, reinforcement conditions, and under both "reward" and "punishment." In other words the subject was required to perform on the learning task either under the condition involving verbal "reward" and "punishment," or non-verbal "reward" and "punishment." Hence each subject was run individually and served as his own control.

The learning task required that a subject learn to make a correct motor response to a visually presented word. Two different lists of words, equivalent in difficulty, were used, and were presented in a counter-balanced order for the reinforcement conditions. In the case of the verbal "reward" condition the experimenter said "right" for a correct movement and nothing for a wrong movement. In the verbal "punishment" condition, the experimenter said nothing for a correct movement and "wrong" for an incorrect movement. The same procedures were used in the non-verbal reinforcement condition except for the following modifications: Under the "reward" reinforcement the experimenter gave cigarettes and/or candy for a correct movement and nothing for an incorrect one, whereas under the "punishment" reinforcement the experimenter took cigarettes and/or candy away for an incorrect movement and did nothing for a correct movement. The reinforcement was presented in a fixed order so that "reward" always preceded "punishment."

The results indicated that the subjects with a "poor" premorbid level of adjustment significantly improved their performance under both the verbal and non-verbal reinforcement designated as "punishment," as compared to the "reward" reinforcement and to the performance of the subjects with a "good" premorbid history. No significant difference was found between the effects of verbal and non-verbal reinforcement although the results suggested that verbal "punishment" was more effective in bringing about a change in performance. Schizophrenic subjects with a "good" premorbid level of adjustment showed no significant improvement in performance under any of the experimental conditions.

The experiment was interpreted as supporting the concept that reinforcement consisting of "punishment" serves

to improve the performance of schizophrenic subjects with a relatively "poor" premorbid level of adjustment.

Microfilm $2.75; Xerox $3.00. 54 pages.

A FACTORIAL ANALYSIS OF THE "BASIC" INTEREST PATTERNS OF TWO HUNDRED WOMEN COLLEGE STUDENTS IN VARIOUS CURRICULAR GROUPS

(Order No. Mic 60-4442)

Anita C. Montague, Ph.D.
Temple University, 1960

The purpose of this study was to investigate the vocational and educational interest patterns of college women in various curricula by means of a factor analysis of their responses to a 300-item Inventory comprised of job titles, school subjects, job tasks, and dichotomous preferences pertaining to nature of work.

The sample was composed of 200 sophomore, junior, and senior women enrolled in various curricula in several local colleges. Among the divisions represented were Liberal Arts, Elementary Education, Secondary Education, Business Education, Art Education, Music Education, and Home Economics. Within the Liberal Arts group some of the "majors" represented were English, Social Science, Psychology, Economics. There was no attempt to obtain a stratified random sample; however, every effort was made to get as wide a distribution as possible among the various college curricula.

A standardized procedure was used throughout each testing session. Nineteen a priori keys were developed and used for scoring the answer sheets. An IBM machine was used both for scoring and the item analysis. The Wherry-Winer Indirect Method of Factor Analysis was used.

Examination of the intercorrelational matrix for the nineteen keys showed that there was overlapping. A Wherry-Doolittle "Z" procedure was employed which resulted in nine unique factors (one eventually dropped out), which accounted for 80 per cent of the variance. After the completion of the factor analysis, eight of the original keys remained as factors, with a total of 180 items (of the original 300 items) having substantial loadings on one or more of the factors and zero or near-zero on other factors. The final factors in order of uniqueness together with tentative names for purposes of reference were as follows: Factor I — "Mathematics" (bi-polar); Factor II — "Entertainment"; Factor III — "Art"; Favor IV — "Human Welfare"; Factor V — "Biological and Physical Science"; Factor VI — "Business" (bi-polar); Factor VII — "Written Communication" (bi-polar); Factor VIII — "Agricultural-Outdoors" (bi-polar). There were two secondary factors whose items had substantial loadings on two factors: Factor IX — "Socio-Business"; and Factor X — "Business-Literary."

In comparing the interest patterns for the various curricular groups it was found that Liberal Arts, Elementary Education and Secondary Education showed similar patterns, but with differences in per cent of number of items chosen under each key. However, there were variations in patterns when these were compared with Business Education, Home Economics and Business Administration groups. For the "major" groups within the Liberal Arts division, there were also variations in patterns which were consistent with what might be expected from the respective majors.

Within the limitations of this study, the following conclusions were drawn:

1. There appear to be eight "basic" interest factors. These are the orthogonal group factors that resulted from the factor analysis. Each factor has a number of items with significant loadings (some bi-polar), thus enabling the construction of a scoring key for the inventory. Eleven other factors which were thought to be present on the basis of the judgment of a group of experts did not appear on the final list.
2. There also appear to be two secondary factors which have items with significant loadings on two of the basic factors.
3. There were eleven a priori keys that did not remain as basic factors after the factor analysis was completed.
4. A study made of the reliability of the inventory by examination of the sets of comparable items indicates a high degree of internal consistency.
5. In comparing the various curricular groups, it appears that there are different "basic" interest patterns among the various divisions of colleges and for specific "majors" within the same division.

Microfilm $2.75; Xerox $5.80. 119 pages.

SOME EFFECTS OF MATERNAL INCONSISTENCY AND EMOTIONALITY LEVEL UPON OFFSPRING BEHAVIOR AND DEVELOPMENT

(Order No. Mic 61-2495)

Donald Ray Ottinger, Ph.D.
Purdue University, 1961

Major Professor: Mark W. Stephens

This experiment was designed to test hypotheses concerning the effects of maternal inconsistency and mother emotionality level on offspring behavior and development. The specific hypotheses were that maternal inconsistency would have deleterious effects upon the emotionality and physical development of offspring. It was also predicted that mother emotionality level would affect offspring emotionality and development.

Harvard-Wistar strain rats were used as experimental subjects.

Maternal emotionality level was determined on an individual difference basis. The mothers were divided into low, medium, and high emotionality groups.

Maternal inconsistency was operationally defined as a situation in which mothers were rotated between two litters on a daily basis. This resulted in a litter being nursed on alternate days by either the natural mother or one other foster mother. Rotation of mothers was always done within a level of emotionality for the major experiment. The

offspring were never contacted by E until weaning at 21 days.

The adult behavioral and weight data of the offspring were in marked support of both hypotheses. The offspring that experienced maternal inconsistency were significantly more emotional in adulthood than offspring that experienced maternal consistency. Offspring emotionality was significantly and directly related to the emotionality level of the mother. It also significantly affected the adult body weight.

In an attempt to maximize inconsistency, a second experimental group was added that rotated mothers of high and low emotionality. Thus, the offspring of this experiment were alternately nursed by a high and a low emotionality mother. It was predicted that the offspring from this experiment would be more emotional than even the offspring that experienced rotated high emotionality mothers. This prediction was not supported. The behavioral data of these offspring did suggest that the results of the major experiment had an experiential basis rather than a congenital basis.

Measures of some aspects of maternal behavior failed to indicate what aspects of the pre-weaning experience were responsible for the marked differences among experimental groups.

The findings were discussed in a learning context and the value of these maternal variables to personality theory was stressed. Suggestions for further research on these variables were offered.

Microfilm $2.75; Xerox $5.60. 111 pages.

THE EFFECTS OF GROUP COUNSELING ON INTERPERSONAL RELATIONSHIPS, ANXIETY LEVEL, INTELLECTUAL FUNCTIONING, AND CERTAIN PERSONALITY CHARACTERISTICS IN A PLANNED WORKSHOP EXPERIENCE.

(Order No. Mic 61-2726)

Martin Reiser, Ed.D.
Temple University, 1961

This study was designed to test two hypotheses. First, that a planned vocational experience of twelve weeks duration will favorably affect interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics. Second, that the addition of group counseling to a planned vocational experience of twelve weeks duration will more favorably affect interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics than will the workshop experience alone. The validity of these assumptions was evaluated by comparing a counseled and a non-counseled group for change in the above-mentioned areas within the group and between the two groups.

For purposes of investigation group counseling was defined as non-directive, group-centered discussion. Interpersonal relationships was defined in terms of specific areas, namely family relationships, male-female relationships, attitude toward male authority, and frustration in interpersonal relationships. Anxiety level was defined as manifest discomfort resulting from tension in affective situations. Intellectual functioning was here defined by Wechsler's concept of global intelligence. Certain personality characteristics, as evaluated in this research, were designated as dominance versus submission, conscientiousness and persistence versus casualness and undependability, adventurousness versus shyness, and self-sufficiency versus group dependence.

Two groups, each containing sixteen subjects, were utilized. The selection of subjects was made randomly from the incoming population of the Work Adjustment Center. All of the subjects were males between the ages of sixteen and fifty-five and were considered unemployable on entering the workshop program. One group was given group counseling three-times-weekly over the twelve-week process. The other group received no group counseling over the twelve-week period.

The Wechsler Adult Intelligence Scale was chosen to measure changes in intellectual functioning. This test was selected because it is a well-established instrument having acceptable validity and reliability scores and because it is also useful for subtest analysis as well as total score measurement.

In order to measure changes in interpersonal relationships, a multiple-choice adaptation of the Thematic Apperception Test was used. This technique was utilized in order to obtain objective measures of change in these areas. The 16 Personality Factor Questionnaire was used in attempting to measure changes in anxiety level and in certain personality characteristics. This test was selected because it is a factor-analyzed test which looked promising in yielding useful research data. Rating Scale A was constructed as an independent criterion so that the work foremen could evaluate each member of both groups on four variables in the work setting during the twelve-week process.

Viewing the results as a whole, statistically-significant support is not given to the first hypothesis that a planned vocational experience will favorably affect interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics. Statistically-significant support is not given to the second hypothesis that the addition of group counseling to the workshop program will result in greater improvement in interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics than will the workshop experience alone.

There were trends in the data, though not significant statistically, in the directions posited by hypothesis one and hypothesis two. This suggests the possibility that the relative stability of the variables under consideration and the short time period of twelve weeks in which to effect changes, did not allow improvements in process to reach a significant level. The present statistical results tend to agree with results of Rorschach studies indicating that successfully rehabilitated clients show no basic personality changes. Microfilm $2.75; Xerox $6.80. 141 pages.

THE GENERALIZATION OF VERBAL CONDITIONING

(Order No. Mic 61-2503)

Anna Maria Larson Rosenberg, Ph.D.
Purdue University, 1961

Major Professor: Robert C. Nichols

The major purpose of the present study was to determine whether or not the effects of operant conditioning of verbal behavior generalize. A second purpose was to study the effects of relatively minimal experimenter differences on the rate of operant conditioning.

Seventy eight male undergraduates were used as subjects in this study. During the conditioning phase subjects were presented with cards from which they were to choose a pronoun and an adjective to use in constructing a sentence. There were three pronouns and two adjectives on each card. In the reinforcement group "good" was said by the experimenter whenever a subject chose a negative adjective. Control group subjects received no reinforcement.

During the generalization task, subjects were required to describe a person presented in a photograph. Subjects were to choose ten adjectives from a list of the forty adjectives used during the learning phase. There were three versions each of three pictures (in focus, slightly blurred, and very blurred). Three versions of each scene were utilized in order to increase the possibility of achieving generalization by increasing the range of instances where generalization could occur. A tenth picture was used to test for position effect. There was only one version of this photograph which half the subjects saw as the first picture of the series and half as the last picture. One half of all the subjects were tested by a male experimenter and one half by a female experimenter. The two experimenters were of similar age, weight and height.

Following the generalization procedure, all of the subjects were given a standard interview to determine if they had been aware of the reinforcement contingency.

The results of the experiment indicated that learning had definitely occurred. There was no evidence, however, that the effects of conditioning generalized to the post-conditioning task. Experimenter differences had no effect on either learning or generalization. Data from the interview indicated that fifteen per cent of the subjects were aware of the reinforcement contingency.

The findings concerning learning and awareness are in accord with previous research. Although the reinforcement group as a whole showed evidence of learning, the subjects showed much variability in their response to reinforcement.

The analysis of the experimenter differences variable indicated that when the experimental procedures are kept at a simple level, minimal experimenter differences in themselves have no effect on verbal conditioning.

Failure to achieve generalization in this study may have been due to the fact that the learning and generalization tasks used in this study were quite different from each other. It was suggested, that in future research one might want to change the learning procedure so as to increase the chances of achieving generalization in a situation where the learning and generalization tasks are quite different. Furthermore, in future research, one might wish to sample generalization tasks of varying similarity to the conditioning situation to establish a gradient of generalization.

Microfilm $2.75; Xerox $7.60. 161 pages.

THE EFFECTS OF SOCIAL REINFORCING VARIABLES ON THE WORD RECOGNITION RESPONSES OF SCHIZOPHRENIC AND NON-PSYCHIATRIC PATIENTS

(Order No. Mic 61-1509)

Joseph G. Rosenfeld, Ph.D.
Temple University, 1961

The differential effects of interpersonal situations and social motivational factors on the performance of schizophrenics have become the focus of considerable research interest. Since language plays an important role in social communication and in the thought process and since the schizophrenic is purportedly extremely sensitive to people, this study attempted to investigate differences in the report of patients' perceptions of English words, matched according to word length and frequency of usage, following the social reinforcing variables of praise, censure, and a neutral or non-evaluational situation. Two lists of words were selected, half of each list contained words with a person meaning and half without this meaning. The hypotheses being tested were that following a social motivation condition schizophrenics would show differential reactions to people and non-people words, especially under censure conditions, and that non-psychiatric subjects would show no significant differences regardless of the social motivation used.

Each of the 20 people and 20 non-people words, selected from the 1000 most frequent words of the Lorge-Thorndike count, were typed on an electric typewriter with 20 carbon copies; each carbon copy of a word was mounted on a 3 x 5 card and covered with scotch tape. They were arranged in groups so that the least clear copy was first and the clearest copy was last. All subjects were administered the same words and tasks in precisely the same order.

Administered were the following tasks in the order given: 1. A standard near point card to check vision. 2. An intelligence measure (Shipley-Hartford vocabulary test). 3. The pre-treatment perception list. 4. A word association test utilizing the same words as the perception list, used primarily as a fill-in test and as an additional test on which to "evaluate" the subject. 5. A progress evaluation or motivational variable (praise, censure, or neutral). 6. A post-treatment perception list. 7. A post-treatment word association task as a fill-in measure and as a task on which to positively "evaluate" all subjects before terminating the session.

The subjects were selected from a Veterans Administration Hospital. 45 schizophrenic patients were selected from the neuropsychiatric wards and 45 non-psychiatric patients were selected from the medical-surgical wards. Statistical analysis of the data was in terms of difference scores between pre and post-treatment performance. The mean perception score difference and the differences in guessing were investigated. The analysis of variance, t, F, and sign tests were used where appropriate.

The findings revealed no significant differences in means that could be attributed to the effects of the treatment conditions, in either the non-psychiatric or the schizophrenic patients in their reported ability to discriminate words and in the number of guesses they made. Therefore, in so far as the hypotheses of the study were concerned, that the treatment conditions would produce significant differences for people and non-people words for the schizophrenics and that the schizophrenics would differ from the non-psychiatric subjects in their responses to the treatment conditions for the same kind of word, the findings were negative. However, in number of guesses reported to the blurred words, the treatment conditions differentially affected the groups' variability of response. The non-psychiatric group, under the stress produced by the censure conditions, was significantly more variable than the non-psychiatric neutral and praise groups on the non-people words, but not on people words. The censure schizophrenic group was significantly more variable than the schizophrenic neutral and praise groups on people words, signifying that they reacted in a more individualized way toward person oriented stimuli.

While the non-psychiatric censure group differed in variance from the other non-psychiatric groups only for changes in guessing or hypothesis-making to non-people words, in the schizophrenic censure group this tendency was more generalized, in that it differed from the other non-psychiatric groups in variance with both people and non-people words.

As far as changes in hypothesis-making were concerned, schizophrenic subjects following praise treatment were less variable in their responses to words with a person meaning than they were to non-person words. Also with person words they were not significantly different in the variability of their performance from non-psychiatric subjects under neutral and praise conditions.

Thus it was noted that the effects of stress upon performance varied with the individual. However, this variability was systematic rather than random, and was dependent on the presence or absence of interpersonal aspects of the perception and on whether the subject was normal or schizophrenic.

Microfilm $2.75; Xerox $4.40. 85 pages.

EFFECT OF EARLY EXPERIENCE AND AGE UPON LEARNING

(Order No. Mic 61-2509)

Shirley Allen Smith, Ph.D.
Purdue University, 1961

Major Professor: Victor H. Denenberg

This study was designed primarily to investigate the long term effects of stimulation during infancy by testing rats between the ages of 50 to 200 days. The effects of test age on emotionality and adequacy of performance in an avoidance training situation were also studied.

One-hundred and forty-four Harvard Wistar rats were randomly assigned to one of three infantile experience groups. Shocked Ss were placed into individual compartments of a small shock box and shocked for three minutes a day on days 11-20. Handled Ss were treated in the same manner as the shocked Ss except that the shock source was not connected. Ss in the control group received no extrinsic infantile stimulation. All Ss were also randomly assigned to one of four groups on the basis of whether adult testing would begin at 50, 100, 150, or 200 days.

Ss were weaned and weighed at 25 days of age. On the first day of adult testing the Ss were given an open-field test and weighed. This was followed by 15 days of avoidance training and two days of extinction. On the nineteenth day of adult testing a second open-field test was given and, during the week that followed, the Ss were sacrificed, weighed, and the adrenal and thymus glands removed.

It was found that infantile experience and age of adult testing did not interact in their effect on avoidance training performance. Infantile shock was shown to have an adverse effect on adequacy of performance in adult avoidance training regardless of the age in adulthood at which training was begun. Infantile handling was shown to have a slight facilatory effect on adult avoidance training performance.

Ss which received no extrinsic stimulation in infancy were found to be significantly more emotional as adults than the two infantile experience groups. Age interacted significantly with infantile experience for the emotionality measures. On three of the four behavioral emotionality measures the shocked Ss were less emotional than the handled Ss.

No significant differences attributable to infantile experience were found for the adrenal weights. Thymus weights, paradoxically, indicated that the shocked Ss were most responsive to stressful stimulation while the handled Ss were least responsive to such stimulation. Control Ss weighed more than the infantile experience groups at weaning and less than these groups as adults. The adult weight differences were still evident at 225 days of age. There were indications that absence of extrinsic infantile stimulation resulted in modifications of the over-all growth curve for the control Ss and that the stress of avoidance training increased these modifications.

Results were discussed in terms of the theoretical formulations of Denenberg (1958b, 1959), and it was concluded that, in general, these results were consistent with his position. Exceptions were pointed out and discussed. Consideration of the present findings in conjunction with previous research suggested that such factors as genetic differences, adult stress, and social conditions interact with the effects of infantile experience.

Performance in the avoidance training situation was shown to improve as a function of age. Ss became less emotional as a function of age if emotionality measures were taken before avoidance training, but they became more emotional as a function of age if emotionality measures followed avoidance training. It was concluded that the existence of a single "age-learning function" seems unlikely. Such factors as species used, prior experience of Ss, type and difficulty of task, and incentive play important roles in the function obtained. It was suggested that the relationship between age and emotionality was equally complex. Microfilm $2.75; Xerox $4.80. 94 pages.

A COMPARATIVE STUDY OF THE INTEREST AND PERSONALITY PATTERNS OF MAJOR SEMINARIANS

(Order No. Mic 61-1584)

Rev. Cyril Robert Sutter, C.PP.S., Ph.D.
Fordham University, 1961

Mentor: Rev. Joseph Keegan, S.J.,

The basic hypothesis of this study is that the interest and personality profiles for groups of seminarians are more similar to each other than to the profiles for men-in-general but that there will be differences among the seminary groups due to different environmental backgrounds.

The Kuder Preference Record -- Vocational Form CM and The Guilford-Zimmerman Temperament Survey (GZTS) were administered to 1693 major seminarians studying in 24 diocesan seminaries and representing 126 dioceses in the United States. All the subjects had spent at least two years in the major seminary and were presently engaged in the study of theology.

The t test applied to the mean scores indicated that the total sample of seminarians differed significantly from men-in-general on all the interest scales except the artistic scale. Their outstanding interest was in social service. They also scored considerably above average on the literary and musical scales. Little interest in mechanical, computational, and scientific pursuits was exhibited and scores somewhat below average on the outdoor, persuasive, and clerical scales were obtained. Significant t's were obtained for all ten of the personality traits measured by the GZTS. The seminarians scored higher than the original normative sample of college students on the R (Restraint), E (Emotional Stability), F (Friendliness), T (Thoughtfulness), and P (Personal Relations) scales. They scored lower on the G (General Activity), A (Ascendance), S (Sociability), O (Objectivity), and M (Masculinity) scales. In general, their interests and personality should be assets in the performance of priestly duties.

The effects of seven environmental factors upon the present interest and personality profiles of seminarians nearing their goal, the priesthood, were studied. The factors considered were: 1) the geographical location of the seminary in which the seminarians are presently studying; 2) the area of the United States in which the seminarians lived prior to entering the seminary; 3) the population per square mile of the home dioceses of the seminarians; 4) percentage of Catholics in the home dioceses; 5) American vs. foreign born parents; 6) the socio-economic status of the seminarians' families as determined by the occupation of the father; and 7) the high school attended -- minor seminary, Catholic, or public high school.

In order to take full advantage of the large sample, all of the seminarians were used in the study of each environmental variable. This method permits a comparison of the relative influence of the several variables and indicates which of them could be most fruitfully isolated for future study. It does not, however, indicate precisely how much of the differences obtained is due to the particular variable under consideration, since within each group the other variables are operating simultaneously. The total sample of seminarians was divided into groups on the basis of each of the seven environmental variables and the analysis of variance technique was applied to determine whether there were any significant differences. Where such differences were obtained Tukey's test for the significance of differences between means was used to determine which particular groups were responsible for the significant F ratios.

The profiles for the groups of seminarians were in all instances found to be more similar to each other than to the profiles of men-in-general. The significant F ratios obtained for all the environmental variables except the American or foreign born parentage of the seminarians indicate various modifications of the interest and personality profiles engendered by differing environmental backgrounds.

The environmental variables indicated by this study as the most likely prospects for future research are: 1) area of the country; 2) density of population (or perhaps rural-urban or size of home city); and 3) socio-economic status. As far as the personality profile is concerned the type of high school attended would seem to be even more fruitful. Finally since other investigators report personality differences for American vs. foreign born parents, and since there was no evidence for such differences among seminarians, this factor might receive further attention.

Microfilm $2.75; Xerox $8.00. 172 pages.

THE EFFECTS OF GROUP COUNSELING IN A CONTROLLED WORKSHOP SETTING ON ATTITUDE, MANUAL DEXTERITY AND ABILITY TO PERCEIVE CORRECT SPATIAL RELATIONS.

(Order No. Mic 61-2727)

Marvin Waldman, Ed.D.
Temple University, 1961

The present study is an investigation of the effectiveness of group counseling combined with a sheltered workshop program, and a sheltered workshop program alone, in alleviating negative attitudinal factors, slowness of gross and fine manual performance, and perception of spatial relations.

Group counseling was defined as an intensive, short-term group process with a client-centered orientation. Controlled workshop as used here is a simulated work situation where appropriate peer and supervisor relationships are structured by psychologists. Attitude is defined as "a learned implicit process which is potentially bipolar, varies in its intensity, mediates evaluative behavior and is a prime part of the internal anticipatory mediational activity that operates between most stimulus and response patterns." Manual dexterity ability is operationally defined by the time within which a client correctly assembles an assigned performance task. Spatial relations ability is operationally defined as the time within which size and shape of objects are correctly perceived.

The Semantic Differential was the instrument used to measure meaning towards self-as-worker, work, co-worker, and supervisor. The Crawford Small Parts Dexterity Test, tweezer and screwdriver subtests, was used to measure fine dexterity; the Minnesota Rate of Manipulation Test was used to measure gross dexterity; and the Minnesota Spatial Relations Test was used to measure perception of

spatial relations. Speed of performance on these instruments was used as the criterion of improvement. A five-point scale ("F Scale") was used by the foremen to rate client manual performance and attitude toward self-as-worker, work, co-worker, and supervisor. This "F Scale" was the independent criterion.

The experimental process included testing two groups both initially and at the termination of the twelve-week program. One group attended group counseling sessions, while the other did not. The sessions were an hour each, three days a week with six to nine members in attendance each time.

The research sample consisted of 32 males ranging in age from 16 to 55. The population was that usually referred to a sheltered workshop. Their common problem was an inability to gain and/or sustain themselves in an employment setting because of emotional disablement, organic brain damage, and/or retardation. Though physical disabilities may have been present in a few situations, emotional disablement was judged as being most responsible for their unemployment.

In general, the workshop program alone was not found to be significantly effective in improving meaning toward self-as-worker, work, co-worker, and supervisor. Some support was given to the hypothesis that the workshop program alone was effective in improving spatial relations speed. Introducing group counseling into the workshop program did not effect significant change in the predicted direction for the variables self-as-worker, work, co-worker, and supervisor. Therefore, it must be generally concluded that the addition of group counseling to the workshop program did not effect measurable meaning change for the above variables in the hypothesized direction. While some support was given the hypothesis that group counseling in the workshop program is effective in improving manual performance speed, as measured by objective tests, ratings by foremen were significantly lower for those who were counseled.

Some reaction to the group counseling process was suggested by non-significant trends in the data in the form of what has been referred to as "therapeutic regression" for the counseled group. This negative effect suggests the need for careful evaluation of group counseling in a workshop setting, especially in light of the time required for the process. This may also have been an artifact of the permissive approach used and should not be generalized to other counseling techniques or orientations.

Microfilm $2.75; Xerox $7.80. 168 pages.

AN EXAMINATION OF PERCEPTUAL AND COGNITIVE RIGIDITY IN DEAF ADOLESCENT BOYS

(Order No. Mic 61-386)

Martin Henry Wodin, Ph.D.
New York University, 1960

Chairman: Professor Howard M. Newburger

Problem

It was the purpose of this study to examine the effects of deafness in adolescent boys on perceptual and cognitive organization. The hypotheses were that deaf subjects would tend to significantly complete incomplete configurations in a Perceptual Closure scale, perseverate longer in a Constancy scale, and sort more concretely and less abstract-conceptually in an Object Sorting test than hearing subjects. It was assumed that a handicap in one sensory process would influence other sensory and cognitive processes in a compensatory manner, and in the direction of increased rigidity.

Procedure

The Taylor Perceptual Closure Scale, the Frenkel-Brunswik Constancy Scale, and the Goldstein-Scheerer Object Sorting Test were administered to fifty-one organically deaf adolescents at the New Jersey School for the Deaf and fifty-one non-deaf subjects selected from volunteers at the Pennington School, both in New Jersey. The three tests required approximately seventy-five minutes to administer.

Results

All three hypotheses of the study were confirmed in an analysis of variance. However, when analysis of covariance was applied to the closure-deafness relationship, the difference was not found to be significant.

Conclusions

The results of this study indicated that (1) deaf adolescent boys significantly closed more in reproducing incomplete configurations than non-deaf adolescent boys, but this difference was found to be related more to length of residency than deafness; (2) deaf adolescent boys perseverated significantly longer in identifying a changing figure than non-deaf adolescent boys; (3) deaf adolescent boys significantly grouped and defined objects concretely and functionally more frequently, and abstract-conceptually less frequently, than non-deaf adolescent boys; (4) deaf adolescent boys, generally, showed greater perceptual and cognitive rigidity than non-deaf adolescent boys.

Microfilm $2.75; Xerox $5.00. 98 pages.

PSYCHOLOGY, EXPERIMENTAL

AN INVESTIGATION OF THE EFFECTS OF SOME SCHEDULES OF INTERMITTENT REINFORCEMENT ON THE PRECISELY TIMED RESPONSE OF THE RAT

(Order No. Mic 61-1857)

Henry William Barnes, Ph.D.
University of Pittsburgh, 1961

Twelve male albino rats were trained under conditions of water deprivation on a response differentiation to duration contingency. They were required to hold the bar down for no less than 0.5 seconds and release it before 0.6 seconds, giving an interval of 0.1 second during which release of the bar was reinforced by water. No exteroceptive cues

for releasing the bar were available to the animal. On completion of training, the animals were placed in groups of four on schedules of intermittent reinforcement. Three schedules were used at three levels each. One schedule (designated $FR_T n$) reinforced the first response within the above time limits following n responses of any duration. The second schedule (designated $FR_S Rn$) reinforced the first response within the prescribed limits following n responses which fell within the time limits. Each of these schedules was carried successively to the levels of n = 2, 5, 8. The third schedule (designated FIn) reinforced the first response within the time intervals following the lapse of n minutes after the previous reinforcement. This schedule used n's of 2, 4, and 6 successively. Finally, the groups were divided in two and half of each group was returned to the training schedule with the time limits retained and the other half retained on the final intermittent schedule with the time limits removed.

In general, the results of the study may be summarized as follows:

1. Some of the phenomena, e.g., drift, blow-up, previously reported by Stelter et al. (1959), were again apparent in the initial stages of the present study.

2. There was no apparent relationship, either within or between animals, between rate of responding and per cent of responses reinforced. This also corroborated evidence presented by Stelter, et al.

3. Appreciable economies of time in training were effected by making the successive approximations to the final time intervals in much larger steps than previous investigators reported.

4. The intermittent schedules resulted in varying degrees of disruption of the timed response. The FR_T schedule had very little effect until the final level ($FR_T 8$) was reached. The $FR_S R$ and FI schedules were about equally disruptive, both resulting in extreme variability and longer response durations. The animals, under the FI schedules, showed tendencies to form the scalloped pattern of responding typical of those formed on fixed interval schedules in undifferentiated operant conditioning.

5. The variance of the distribution of response durations proved to be the most sensitive indicator of the effects of the schedules.

6. The animals which were returned to the conditions of total reinforcement showed small amounts of deficit by comparison with their preschedule performance. The persistent effects of the schedules seemed to be a function of the degree of limitation placed on availability of reinforcement. Those animals retained on schedules with time limits removed remained highly variable in their performance.

An interpretation of the data was proposed within the framework of a neurological model after the manner of Hebb (1949) and several hypotheses proposed concerning the neurological mechanisms underlying the phenomena of timing behavior. Finally, a program of research to test these hypotheses was proposed.

Microfilm $2.75; Xerox $3.80. 67 pages.

EFFECTS OF MESCALINE ON SEVERAL BEHAVIOR PATTERNS IN THE RAT, A PSYCHOPHARMACOLOGICAL STUDY.

(Order No. Mic 60-3781)

Stephan Lewis Chorover, Ph.D.
New York University, 1960

A second listing. For Abstract please see page no. 283.
Microfilm $2.95; Xerox $10.35. 226 pages.

A PHARMACOLOGICAL STUDY OF ELECTROCORTICAL ACTIVITY AND LEARNING IN THE RAT

(Order No. Mic 61-2313)

Conrad Consalvi, Ph.D.
Vanderbilt University, 1961

Supervisor: Professor Gilbert W. Meier

This study dealt with the influence of high and low levels of cortical activation on learning efficiency in the rat. An attempt was made to manipulate activation level through two media: first, through stimulation of the subject's normal receptor mechanisms by placing it in a learning situation, a water version of the Dashiell maze, under conditions intended to produce a moderate or a high level of arousal; second, through the administration of drugs known to directly effect the reticular activating system, physostigmine (a cholinergic) and atropine (an anticholinergic). The drug dosages required to produce the desired alterations in electrocortical activity were determined through EEG procedures.

The over-all design of the study involved six groups of eight animals: one series of three groups was subjected to the maze under conditions intended to produce moderate stress (cool water), and a second series of three groups under conditions intended to produce high stress (very cold water). Under each of the two stress conditions, one group received a reticular stimulant (physostigmine); a second group a depressant (atropine); and the third group was injected with a placebo (Ringer's solution). Four measures of learning were recorded: time, errors, stereotypy, and errorless trials. Activity measures were also taken under normal and post-injection conditions.

The following predictions were made: (1) the low-stress control group would perform significantly better than the high-stress control group; (2) under low stress, atropine would impair and physostigmine would enhance performance relative to the low-stress control group; (3) under high stress, atropine would enhance and physostigmine would impair performance relative to the high-stress control group. It was stated further that if the control groups did not differ significantly, the experimenter would estimate the stress level as high or low, and that the predictions of relative group performance previously made for high or low stress would hold.

The analyses of the results revealed that the control groups did not differ significantly on any of the learning criteria. On the basis of the general behavior of the animals during the test situation, the stress level induced by

the maze was estimated as high for all groups. Consequently, no observations could be made regarding the interactions of the drug treatments with low stress.

The predicted interactions between the drug treatments and high environmental stress were supported to some extent, but not entirely. Conspicuous in the results were the unexpected significant differences between the physostigmine groups on all four learning criteria. However, the high-stress physostigmine group, which consistently violated the predictions, also had a deviant performance of an important activity measure. On the basis of the performances of the other groups, it was inferred that atropine tended to enhance and physostigmine tended to impair learning under what was assessed as high stress.

Microfilm $2.75; Xerox $4.60. 87 pages.

HUMAN DISCRIMINATION OF AUDITORY DURATION

(Order No. Mic 61-1733)

Carleton Douglas Creelman, Ph.D.
University of Michigan, 1961

A series of related experiments was performed which measured human ability to discriminate durations of auditory signals. A two-alternative forced-choice procedure was used: two sine-wave signals of identical amplitude and frequency, differing only in duration, were presented sequentially on each trial. The order of presentation was random, and the observers' task was to state, for each trial, whether the longer signal had occurred first or second. The signals were presented in a background of continuous white masking noise, which was held at a constant level throughout the experiments. Paid observers worked two hours daily for the course of the experiments. Sufficient data were thus available to allow separate treatment for each observer.

The independent variables were the signal voltage, the "base" duration, T, and the increment duration ΔT. Separate experiments assessed the functional effect of each of these variables on discrimination. These were used to predict the results of two further experiments.

The model used in this prediction was derived from statistical decision theory. Duration measurement was assumed to be accomplished by a "counting mechanism," operating on impulses generated over the relevant duration. The source of these impulses was assumed to be random. Limitations on performance were assumed to come from uncertainty regarding the end-points of the time interval, and from limited memory.

These considerations led to the formula:

$$(d')^2 = \frac{\lambda}{1 + KT} \cdot \frac{\Delta T^2}{2T + \Delta T + \sigma_v^2},$$

where d' is the dependent variable, a normal transformation of probability of correct response. The constants λ and K were respectively measures of "counting rate" and memory decay with time, estimated separately for each observer, and σ_v^2 was an inverse power function of signal voltage, a measure of uncertainty regarding starting-time and ending-time of the signals. The decision processes underlying this formula were presented as a general model for discrimination of durations, and shown to agree with the data regarding auditory signals.

Microfilm $2.75; Xerox $3.80. 66 pages.

PARAMETER INVARIANCE IN MODELS FOR LEARNING

(Order No. Mic 60-3649)

Curt F. Fey, Ph.D.
University of Pennsylvania, 1960

Supervisor: R. R. Bush

This paper investigates two models for learning: a linear model proposed by Bush and Mosteller and a non-linear model developed by Luce. Specifically, an attempt has been made to determine if data from two slightly different experimental situations can be described by the models without changing the parameters.

Two groups of rats were trained in a T-maze. One group was always rewarded with food on one side, the other group received a food reward with probability 0.75 on one side and 0.25 on the other side. Model statistics were computed for both groups, using parameters estimated from the group that was always rewarded on the same side, and compared with the experimental data.

It was found that there is good agreement between the models and the data of the continuously reinforced group, from which the model parameters were estimated, but the fit to the data of the partially reinforced group leaves something to be desired.

Microfilm $2.75; Xerox $3.80. 69 pages.

AN EXPRESSION FOR THE TEST CHARACTERISTIC KURTOSIS IN TERMS OF ITEM PARAMETERS AND AN ESTIMATE OF A QUANTITY APPEARING IN THIS EXPRESSION

(Order No. Mic 61-2369)

Donald Aaron Goldstein, Ph.D.
The Pennsylvania State University, 1961

Several authors have called attention to the possibility of controlling test score distributions through proper item selection. It has been shown that in order to do this, one must know the relationships between item parameters and the first four moments of a test score distribution. As the relationships between the first two moments and item parameters were known, this investigation focussed upon the fourth moment, kurtosis.

An expression for the test characteristic kurtosis was derived in terms of item statistics. It was shown that kurtosis is affected by item means, variances, covariances, the proportion of people getting combinations of three items correct, and the proportion of people getting combinations of four items correct.

As all other quantities except the last one mentioned appear in expressions for the test characteristics: mean,

variance, or skewness; attention was focussed on p_{ijkl}, the proportion of people getting combinations of four items correct. A means of estimating p_{ijkl} was obtained based upon a solution for the limits these values could take in any particular case. For those cases where the range of possible values of p_{ijkl} might be large, a method for computing an expected value to use as an estimate was provided. This method is based upon a solution for the determination of the exact probability associated with any particular value of p_{ijkl}.

In order to evaluate the adequacy of this estimate twenty-five samples of four items were drawn; five samples from each of five standardized tests used at The Pennsylvania State University. The responses of one hundred individuals to each tetrad of items were randomly drawn, yielding a total N of 2500 cases.

All lower order values of p_i, p_{ij}, and p_{ijk} were computed and used to estimate the p_{ijkl}'s for each of the twenty-five samples of four items used in this study. A comparison of these estimates with the observed p_{ijkl}'s showed close agreement between these two sets of values.

In all twenty-five cases studied, the solution for the limits on p_{ijkl} resulted in markedly truncated distributions of possible values for p_{ijkl}. An examination of these distributions in conjunction with the standard errors of the observed values of p_{ijkl} showed that the effect of the inter-item correlations in determining either the range or the actual values could not be determined.

The point estimate of association for combinations of four items was derived, the numerator of which turned out to be the fifth term of the multinomial expression for kurtosis.

The relationship among the point indices of association for combinations of two, three, and four items was examined both for the actual values obtained from the twenty-five samples and for a fictitious case. The relationships were shown to be inverse when comparisons were made between any two indices at adjacent levels of association.

Finally, the possible effect of low inter-item correlations in producing platykurtic test score distributions was discussed and the possible source of this effect was noted. This was the "tetravariance," the numerator of the point index of association for combinations of four items. Microfilm $2.75; Xerox $3.80. 68 pages.

A LEARNING THEORY EXPLANATION OF PERCEPTUAL DEFENSE

(Order No. Mic 61-2453)

Kurt Haas, Ph.D.
The Pennsylvania State University, 1961

The Problem. The perceptual defense phenomenon, namely that for some subjects there occurs a delay in recognition for stimuli inimical to them has generated a great deal of research and controversy. In order to avoid some of the shortcomings of some of the perceptual defense research the techniques used to evaluate the phenomenon in this study were based on a learning theory explanation proposed by Eriksen. This approach suggested that verbal conditioning techniques be used to bring about changes in the emission rate of certain classes of words. Provided these changes were demonstrated it was expected that corresponding differences in recognition threshold could be observed.

The Procedure. Four groups of randomly selected subjects of 18 each were trained by verbal conditioning procedures. A perceptual recognition situation was devised in which subjects were asked to guess what word they saw. One group was rewarded (experimenter responded "right") every time they emitted a tabu word, another group was rewarded for plural words, and the last two groups were punished (experimenter responded "wrong") every time they emitted respectively a tabu and a plural word. Following this training period the recognition threshold for tabu, plural and neutral words, different from those used in training, was obtained for all subjects.

The Results. The emission frequencies of the reward and punish tabu groups and of the plural punish group were found significantly changed by the conditioning techniques employed. The frequencies of the plural reward group were not significantly changed. Over-all analysis through a 2 x 2 variance design of the influence of the learning procedure upon recognition thresholds showed that the contrasting effects of reward and punishment and of word type were significant. Significant interactions were not obtained. Individual comparisons of the mean recognition threshold scores for the variously reinforced groups with non-reinforced groups were demonstrated not to be significant in three of the four groups contrasted.

The Conclusion. In general the results of the investigation suggested that perceptual defense is a learned response and operates according to the principles of reinforcement. Microfilm $2.75; Xerox $4.80. 92 pages.

COMPARISON OF MONOCULAR AND BINOCULAR COLOR MATCHING

(Order No. Mic 61-1283)

Carl Stuart Hoffman, Ph.D.
The Florida State University, 1961

The binocular mixture of red and green resulting in yellow was compared with monocular mixtures in normal and color blind subjects. A stereoscopic type of color mixing apparatus was used which provided for easy, natural binocular fusion. A photopic adaptation field was also provided. The results were:

1. Binocular yellow was seen by all subjects.
2. The binocular mixture contained less green than the monocular one, the ratio being 6:1.
3. The binocular match was on the average 17 times more variable than the monocular.
4. Variability was not due to binocular rivalry as highly trained subjects who experienced little or no rivalry showed no decrease in variability.

From these data it was concluded that:

1. Binocular matches are different from monocular, implying different physiological mechanisms for each.
2. The basic Hering and Young-Helmholtz theories are insufficient to account for the data.

Microfilm $2.75; Xerox $3.00. 52 pages.

ITEM CHARACTERISTICS AND SKEWNESS OF OBSERVED SCORE DISTRIBUTIONS

(Order No. Mic 61-2374)

John Dennis Hundleby, Ph.D.
The Pennsylvania State University, 1961

The moments of observed test-score distributions may be obtained from knowledge of certain item parameters (e.g., item difficulty). The present study is an investigation of the item parameters necessary to obtain m_3, the third moment, and g_1, Fisher's coefficient of skewness (where $g_1 = m_3/m_2^{3/2}$), of an observed score distribution. Much is known about m_2, therefore emphasis is placed upon m_3.

The assumption is made that all items are scored either 0 or 1. Test score is the sum of the unweighted item scores.

The terms in the following expression were examined in order to show their importance to the test constructor.

$$m_3 = \sum_{i=1}^{K} V_i(q_i - p_i) + 3 \sum_{i<j}^{K} C_{ij}(q_i - p_i) + 6 \sum_{i<j<k}^{K} T_{ijk}$$

where K = the number of items in the test, p_i = the proportion of examinees scoring 1 on item i, $q_i = 1 - p_i$, $V_i = p_i q_i$, C_{ij} = the covariance of items i and j, and T_{ijk} = what is here designated as the trivariance of items i, j, and k.

Examination of the first two terms confirms the view that easy tests will tend to be negatively skewed and difficult tests positively skewed. With a symmetric distribution of item difficulties, and homogeneous item covariances, the first two terms will be zero. With non-symmetric item difficulties, increasing the value of item covariances can be shown to increase the absolute value of the second term only when the covariances are positive. Other implications of these terms are also discussed.

The third term, ΣT_{ijk}, is expressible as a sum of third-order correlations (defined as the correlation of items taken three at a time) and presents some interpretative problems. A given value for T_{ijk} is determined by (1) the difference in association between two items at the 0 and 1 levels of a third, and (2) item difficulties and covariances. An analytic solution for the limits of values taken by the trivariance was presented in terms of item difficulties and covariances. In order to test the hypothesis that an observed value for the trivariance occurs by chance within the limits set by the item difficulties and covariances, an appropriate probability distribution was derived.

Item response data was analyzed from twenty-five triads of items drawn from five different tests of ability and achievement. These triads of items had been administered to twenty-five different groups of one hundred subjects. The hypothesis (H_0) was tested that observed values for T_{ijk} do not differ from an expected value determined by the observed item difficulties and covariances. H_0 was accepted, implying that for these and similar items, the "difference in association" component of the trivariance may be ignored.

Microfilm $2.75; Xerox $4.40. 82 pages.

FOVEAL FLICKER-FUSION FREQUENCY FOR INTERRUPTED LIGHT SUPERPOSED ON STEADY LIGHT

(Order No. Mic 61-2214)

Aaron Hyman, Ph.D.
Columbia University, 1959

This study is concerned primarily with the relationship between critical flicker-fusion frequency (CFF) and retinal illuminance for an interrupted stimulus presented in the rodless region of the retina under conditions of constant light adaptation.

The apparatus used provided a monocular view of a 52-minute-of-arc circular field of fluctuating light surrounded, if desired, by an annulus of non-fluctuating light. The fluctuating light was comprised of two elements: a "steady component" of retinal illuminance and a "periodic component" of retinal illuminance. The latter had a square waveform (i.e., LDR was unity). It was found convenient to describe the fluctuating stimulus in terms of a ratio, $\Delta E/E_o$, wherein ΔE was the amplitude of the retinal illuminance generated by the periodic component and E_o was the mean retinal illuminance generated by the whole stimulus. For brevity of expression this ratio will be called the "amplitude ratio."

Two procedures were followed for determining CFF. In one, the sessions were conducted with the mean retinal illuminance held constant, and within a session the amplitude ratios were varied in random order. In the other, the sessions were conducted with the amplitude ratios held constant, and within a session the mean retinal illuminance was progressively increased in discrete steps. For the major portion of the investigation no surround was employed. Central fixation was maintained for all conditions. Data were obtained for two subjects.

CFF decreased as the amplitude ratio ($\Delta E/E_o$) decreased. Below 400 trolands, the relationship between CFF and log ($\Delta E/E_o$) was approximately linear. At the higher luminance levels, however, the CFF decrement became relatively greater when amplitude ratios were less than 0.1, and for amplitude ratios greater than and less than 0.1 the data could be fitted well by two straight lines. The slope of the CFF vs. log ($\Delta E/E_o$) function generally increased with an increase in luminance level, but portions of the function sometimes showed small reversals in this trend. The presence of a two-degree surround, matched in luminance, did not qualitatively change the appearance of the function. Within experimental error, the Talbot-Plateau law was found to hold for the various amplitude ratios.

In an attempt to uncover causes for the deviations from the linearity found in the CFF vs. log ($\Delta E/E_o$) function, the relationship between CFF and log E_o (mean retinal illuminance) was studied for one subject. Both white and colored stimuli (red, red-green mixtures, and blue-green mixtures) were used. The function contour appeared to be "irregular." For white light the slope of the contour was less for mean retinal illuminances below 10 trolands than for mid-range values; between 10 and 1000 trolands it was approximately constant (disregarding second-order "irregularities"); and above 1000 trolands it leveled rapidly to a maximum. It then became negative, and subsequently positive again. CFF was still increasing when the maximum available illuminance (5×10^6 trolands) was reached.

In addition, the CFF vs. log E_o function seemed to have several "humps" in the mid-range of illuminances, especially when selective filters were used. With this function, the contours for white and red light could not be superposed by shifting one with respect to the other.

To account for apparently systematic deviations from function trends, two assumptions were made: namely, (a) below a "critical" amplitude ratio spatial summation depends on the relative magnitude of the periodic component, and (b) CFF is a resultant of responses from individual mechanisms selectively sensitive to luminance level, spectral energy distribution, and amplitude ratio. Beginning with a modification of Hecht's photochemical theory, and postulating a stochastic process for the transfer of excitation within the visual receptor, a theoretical formulation for the findings was developed utilizing the foregoing assumptions.

Microfilm $2.75; Xerox $5.20. 101 pages.

SUPERVISOR PERCEPTION OF SUBORDINATE ATTITUDES

(Order No. Mic 61-2144)

Thomas Harlan Jerdee, Ph.D.
University of Minnesota, 1961

The problem of this research is to determine the adequacy of a new measure of supervisory empathy, called "differential accuracy" (DAC). This measure is designed to reflect the individual supervisor's ability to estimate differences between his subordinates in response to each item of an employee attitude scale. It has certain methodological advantages over empathy measures used in previous research studies.

The following hypotheses were tested:

1. Reliable differences exist between first-line production supervisors in empathic ability as measured by the DAC score.
2. DAC is positively related to supervisory effectiveness rankings made by top management.
3. DAC is positively related to subordinate attitudes.
4. DAC is positively related to the length of time supervisors have known their subordinates.
5. DAC is not dependent on the amount of within-item response variability among subordinates.
6. DAC is not dependent on the amount of within-item variability of supervisors' predictions.

These hypotheses were tested in a survey of 38 supervisors and 190 subordinates (five subordinates of each supervisor) in three manufacturing plants. Measures obtained for each supervisor were (1) the differential accuracy (DAC) measure of empathic ability; (2) a ranking on over-all effectiveness as a supervisor; (3) a measure of subordinate attitudes; (4) the length of time the supervisor had known his subordinates; (5) the within-time response variability among subordinates on the attitude scale items used in the measurement of empathy; and (6) the corresponding within-item variability of each supervisor's predictions.

The DAC score is defined as follows:

$$x_{ij} = \sum_{k=1}^{K} \left| (X_{ijk} - \overline{X}_{ij.}) - (Y_{ijk} - \overline{Y}_{ij.}) \right|$$

where

X_{ijk} = response of the kth subordinate of the jth supervisor to the ith item,

Y_{ijk} = predicted response of the kth subordinate of the jth supervisor to the ith item,

$\overline{X}_{ij.}$ = mean response of the subordinates of the jth supervisor to the ith item, and

$\overline{Y}_{ij.}$ = mean predicted response of the subordinates of the jth supervisor to the ith item.

The DAC score as defined above actually is a total of the sub-scores obtained for individual subordinates. Each of these sub-scores answers the question, "how much difference is there between the actual departure of the subordinate's response from the group mean, and the corresponding departure predicted by the supervisor?"

The statistical significance of total DAC score differences between supervisors, and the reliability of the DAC measure were studied in each plant by analysis of variance. Relationships between DAC scores and other variables were estimated by the rank correlation coefficient.

The major findings are as follows:

1. There are reliable differences between supervisors in DAC scores.
2. DAC scores are unrelated to supervisory effectiveness ratings, subordinate attitudes, and duration of supervisors' acquaintance with subordinates.
3. DAC scores are almost entirely a function of subordinate response variability and supervisory prediction variability. Low variability of either type results in more favorable DAC scores.
4. The variability of supervisors' predictions is not significantly related to the variability of subordinates' responses.

The major conclusion is that the DAC score is not an adequate measure of supervisory empathy. A favorable DAC score is merely an indication of low variability of subordinates' responses or of the supervisor's predictions, or of both, rather than an indication of accurate perception of subordinate attitudes. There is also some support for the tentative conclusion that supervisors are unable to judge subordinate attitude differences with any substantial degree of accuracy. Microfilm $2.75; Xerox $5.40. 107 pages.

THE EFFECTS OF DIFFERENTIAL REINFORCEMENT OF LOW RATE ON WORD UTTERANCE

(Order No. Mic 61-2215)

Eli Eglons Kapostins, Ph.D.
Columbia University, 1961

In this study the effects of differential reinforcement of low rate (DRL) upon the utterances of a specific word (SVR) among the subject's utterances of other words were investigated in terms of the percentages of different interresponse times (IRT's), response probabilities (IRT's/OP's), and response rates at stable levels of responding and under changes in the schedule and/or the SVR.

Method

The subjects were college students and were instructed to say words. Utterances of the SVR were reinforced according to a given DRL (7, 17, 27, 37, or 47 seconds) with bell sounds during responding and with corresponding financial rewards after each twenty-minute session.

Results and conclusions

1. The subjects' responding was effectively shaped by the DRL schedules, thus demonstrating the effectiveness of the procedure.

2. At the beginning of the experiment, responding tended to yield random IRT's, followed by a decrease first in the percentages of shorter IRT's and then in the percentages of IRT's longer than the required minimum (DRL specification). Thus the effects of non-reinforcement were seen before those of the number-of-reinforcements-per-hour (Reinfs/Hr).

3. The same trend was observable when the DRL schedules were changed. However, with an extinction session interspersed, only the last phase of the process was observable.

4. Only minor changes were found in the IRT-percentage and IRT's/OP's distributions when the SVR was changed with the schedule kept the same. Thus it appeared as if reinforcements had a relatively minor effect on the SVR itself and their main effects were on some kind of "timing mechanism." Three models were presented, but since they all agreed with some aspects of the data, further studies were suggested.

5. Under conditions of stable responding, the modal IRT-percentage classes were just above the DRL specifications, but they tended to be more distant with larger DRL specifications, along with some decrease in their magnitudes.

6. There was no evidence of a second modal class at short IRT's, as found in some previous studies. Speed of learning was proposed as a possible reason for this phenomenon.

7. At stable levels of responding, IRT's/OP's distributions tended to be S-shaped. The effects of non-reinforcement and Reinfs/Hr were suggested to account for the characteristics of the first and the third part of the curve, respectively.

The IRT range over which IRT's/OP's increased varied directly with the DRL specifications.

8. Rates of uttering all the different words did not seem to be controlled by the procedure of this experiment, but the SVR rates yielded reciprocally hyperbolic functions of the DRL specifications. Differences between actual and optimum rates were greater with smaller than with larger DRL specifications, apparently depending upon differential effects of relatively constant differences between actual and optimum mean and median IRT's.

9. Although the pattern of responding with the SVR could be described in terms of some intermediate SVR strength, a reconsideration of this account was suggested upon the following incidental observations: utterances of words in certain sequences, counting the number of intervening words, cyclical variations of the pitch of voice, and reported "feelings of rising tension."

10. Changes in the magnitudes of the IRT's between successive emissions of the SVR formed random runs of increase and decrease.

Microfilm $2.75; Xerox $7.20. 153 pages.

ASYMPTOTIC EFFECTS OF ABSOLUTE AND DIFFERENTIAL MAGNITUDES OF REINFORCEMENT ON INSTRUMENTAL PERFORMANCE

(Order No. Mic 61-1874)

Herbert Lionel Klions, Ph.D.
University of Pittsburgh, 1961

The first part of this study, Experiment I, was designed to determine the terminal acquisition and early extinction effects of two different amounts of reinforcement, and the effects of shifting reinforcement after the performance measures appeared stable. A review of the literature had indicated that acquisition performance improved as a function of magnitude of reinforcement and consummatory time in the goal box. These studies had also suggested that shifts in magnitude of reinforcement resulted in rapid and permanent performance changes. However, in many of these studies there is some doubt as to whether the subjects were responding at asymptote at the conclusion of training. Since some important theoretical formulations were supposed to have been adopted on the basis of asymptotic data, and these studies that were reviewed were limited to relatively few trials, the attempt in the present investigation was to obtain some terminal acquisition data that appeared to be reasonably stable.

In Phase 1, 32 subjects were randomly divided into two groups. One group received 25 pellets at the completion of each trial in a runway, and the second group received a 1 pellet reinforcement. Trials during Phase 1 were continued until a statistical test indicated that there was no further changes in performance with additional reinforced trials. In Phase 2, half the subjects that had been run on 25 pellets were continued on 25 pellets, while the other half were shifted to a 1 pellet reinforcement. Similarly, half the subjects that had been run on 1 pellet were continued on 1 pellet, while the remainder were shifted to 25 pellets. During Phase 3, extinction data were obtained on these four groups.

The results showed that there was no reliable terminal acquisition difference in reciprocal running time between the 25 pellet and 1 pellet reinforcement groups, although the 25 pellet reinforcement group did show a consistently faster starting time throughout the experiment. The procedure of shifting amount of reinforcement after asymptote had no long-term effect on running speed, although the subjects who were shifted from a 25 pellet reinforcement schedule to 1 pellet did show a temporary performance decrement in the runway. There was a trend towards faster extinction for subjects who were on 25 pellets during Phase 2.

In Experiment II, terminal acquisition data were obtained on a 50% reinforcement group, a varied reinforcement group, and a continuously reinforced control group. These groups were subsequently placed on extinction.

A review of the literature had pointed to the acquisition superiority of continuously reinforced schedules over a partially reinforced schedule. However, there were some indications that additional training trials might not show this same relationship. Data obtained on the varied reinforcement group were expected to lend some support to the use of the mediating r_g construct.

There was no significant difference on the terminal acquisition time measures between the 50% reinforcement group and the continuously reinforced group. There was a tendency for the curves for the partial reinforcement group to be consistently higher over all the later acquisition trials, whereas during the early trials the opposite trend was observed. The group on a varied reinforcement schedule showed the poorest performance. Both the 50% and varied reinforcement groups showed a significantly greater resistance to extinction than a continuously reinforced group.

In both experiments it appears that asymptotic data yield results somewhat different from acquisition data based on fewer trials. Therefore, generalizations that have been made from studies that were terminated relatively early in acquisition should be limited to initial stages of training. The results of this study were discussed in relation to the competing response notion and the incentive motivation formulation of contiguity theory.

Microfilm $2.75; Xerox $5.20. 104 pages.

THE EFFECT OF IRRELEVANT ENVIRONMENTAL STIMULATION ON VIGILANCE PERFORMANCE

(Order No. Mic 61-1704)

James Joseph McGrath, Ph.D.
University of Southern California, 1961

Chairman: Professor Ruch

Research has repeatedly demonstrated that human observers are unable to maintain vigilant watch for prolonged periods of time under monotonous conditions of work. Several theories have been offered to explain this fact, but little effort has been made to identify and clarify the discrepancies among these theories. The purpose of this investigation was to test hypotheses derived from two theories of vigilance and to provide additional empirical facts that may lead to the eventual understanding and control of human monitoring behavior.

Hypotheses were derived from Broadbent's "filter" theory and from Hebb's "arousal" theory. According to the filter theory, the vigilance decrement occurs because the observer tends more and more to select irrelevant information from his environment as a monotonous watch continues. When attending to irrelevant aspects of his environment, the observer is unable to process relevant task information and, therefore, tends to miss an increasing number of critical signals as the watch proceeds. According to the arousal theory, efficient response behavior is dependent upon an optimal level of cortical arousal, which is in turn dependent upon a variety of sensory stimulation—relevant or irrelevant. The vigilance decrement is assumed to be a product of lowered arousal resulting from the continued invariance of environmental stimulation during watchstanding.

Thus, the two theories hypothesize opposing effects of irrelevant environmental stimulation: distraction effects hindering detection performance and arousal effects improving detection performance. Two experiments were conducted to determine which of these effects would occur.

In the first experiment 28 observers served in eight one-hour watchstanding sessions on a visual vigilance task. Their task was to detect near-threshold increments (signals) in the brightness of an intermittent light. Signals occurred at random intervals at an average rate of 24 signals per hour. Each observer maintained a vigil in an isolation booth under two conditions of auditory stimulation. During four of the eight sessions white noise was presented, and during the other four sessions a variety of auditory stimulation (music, audio portions of television programs, mechanical noises, etc.) was presented.

In the second experiment 18 observers served in four one-hour watchstanding sessions on an auditory vigilance task. Their task was to detect near-threshold increments in the loudness of an intermittent tone presented through headphones. The signals occurred randomly an average of 24 times per hour. Auditory vigils were maintained under two conditions of visual stimulation. On two of the four sessions the observers were permitted to look through large albums of photographs while monitoring the auditory display. On the other two sessions the observers monitored the display without the albums.

In both experiments a significantly greater percentage of signals were detected when irrelevant environmental stimulation was introduced into the watchstanding environment than when this stimulation was absent. In the first experiment, visual vigilance performance under variety auditory conditions was superior to performance under white noise conditions. In the second experiment auditory vigilance performance with photo albums was superior to performance without the albums.

The results of both experiments were consistent with the prediction derived from the arousal theory of vigilance and were taken as support for that theory. The results were inconsistent with the prediction derived from the filter theory of vigilance and were taken as counterevidence for that theory. Microfilm $2.75; Xerox $4.80. 95 pages.

VISUAL TARGET LOCATION AS A FUNCTION OF NUMBER AND KIND OF COMPETING SIGNALS

(Order No. Mic 61-1900)

David Mark Promisel, D.Eng.
The Johns Hopkins University, 1961

A common problem in the design of man-machine systems is that of presenting information to the man quickly and accurately. The problem may be to present one informational variable, i.e., information that varies along some single continuum, or several informational variables. One method of doing this consists of setting up a relationship between the values, or continua, of the informational variables and the variable aspects of a display. Visual displays are most useful for this purpose because of the

number of ways in which a visual signal can vary. For example, the signals on a PPI are recognized as small lighted areas on the tube face. Informational variables can be presented to a man by assigning meaning to, or coding, the variable dimensions of these signals to represent the information.

Performance in obtaining information from a double-coded visual display was investigated as a function of these variables: (1) the number of target signals on the display; (2) the values of the hue-shape combinations used as target signals; (3) the number of competing signals on the display; and (4) the distribution of this competition between the hue and shape dimensions.

The number of targets, the value of the targets, and the number of competing signals all significantly affect task time---the number of targets having by far the greatest effect. Both task time and errors are greater for some targets than for others, and analysis suggests that hue rather than shape is the critical factor. Both task time and errors are again larger for larger numbers of targets, and task time alone increases with the larger number of competing signals. While there is no difference in task time between location double-coded targets and partially redundant targets, the tasks themselves appear to be different. Microfilm $2.75; Xerox $3.00. 43 pages.

DECISION MAKING IN TWO-PERSON TWO-CHOICE ZERO-SUM GAMES UNDER DIFFERENT INCENTIVE CONDITIONS

(Order No. Mic 61-2395)

Joseph Gray Robertson, Jr., Ph.D.
The Pennsylvania State University, 1961

Estes and other statistical learning theorists have investigated human behavior in one-person two-choice uncertain outcome situations in which the S was required to predict the occurrence of one of two events. In most of these studies knowledge of results was the only reinforcement. Generally, Ss matched the cumulative event proportion with their cumulative response proportion at asymptote. However, this behavior does not maximize the probability of a correct prediction. On the other hand, deriving their predictions from decision-making theory, Siegel and others have demonstrated that a tendency toward probability maximization does occur when the reinforcement of a correct prediction is increased.

Atkinson and Suppes and Estes have recently investigated two-person two-choice zero-sum games in which each S's reinforcement schedule depends on both the 2 x 2 matrix cell probability values and the responses of each S. With knowledge of results as the only reinforcement, Ss did not maximize the probability of a correct prediction. Rather, they conformed to the cumulative event matching prediction of Estes, and the related linear Markov model predictions of Atkinson and Suppes.

The purpose of the two experiments in this study was to determine the behavioral effects of an increase in incentive in two-person game situations of this type. Based on premises derived from decision-making theory, the major prediction of this study was that an increase in the utility of a correct prediction will increase the tendency to maximize its probability. It was assumed that an increase in either reinforcement or the competitive nature of the situation would increase the utility of a correct prediction.

In each experiment 24 pairs of male undergraduates from The Pennsylvania State University were randomly assigned to two equal sized incentive groups, Competition-No Pay and Competition-Risk. The members of each pair, designated as players A and B, predicted which of two lights would illuminate on each of 200 trials. Each player received a score in his counter for a correct prediction. Players under Competition-Risk also lost a score for an incorrect prediction, with each score representing five cents. The apparatus employed was completely automatic.

The Sure game experiment involved a payoff matrix requiring a pure strategy minimax solution. Statistical analysis showed that the player B group mean asymptotic response data supported the decision-making theory prediction since an increase in incentive was associated with a closer approximation to the pure strategy solution. At asymptote the total response proportion was significantly greater than the total event proportion. The player A group data did not support the decision-making theory predictions. However, the data suggest that A had not reached asymptote within the 200 trials. This was attributed to A's more difficult task of determining the more frequent event.

The Mixed game experiment involved a payoff matrix requiring a mixed strategy minimax solution. Statistical analysis revealed that the player B group mean asymptotic response data upheld the decision-making theory prediction as an increase in incentive was associated with a closer approximation to the appropriate mixed strategy response. The player A group data did not support the prediction. However, the data suggest that A had not reached asymptote within the 200 trials. Again, this was attributed to the difficulty of the discrimination task.

Due to many factors which discredit the data for player A in both experiments, the following conclusions were based on the data for B.

1. An increase in the incentive associated with a correct prediction in either a Sure or a Mixed game situation will increase the tendency at asymptote toward probability maximization.
2. An increase in the incentive associated with a correct prediction at asymptote in either a Sure or a Mixed game situation will increase the likelihood that the total response proportion will move away from the total event proportion toward the response proportion required for probability maximization.

Microfilm $2.75; Xerox $5.00. 100 pages.

THE CONSISTENCY OF INDIVIDUAL DIFFERENCES IN CONDITIONABILITY IN A VERBAL CONDITIONING SITUATION

(Order No. Mic 61-2398)

Thomas John Scott, Ph.D.
The Pennsylvania State University, 1961

Recent studies of verbal conditioning have included efforts to relate conditionability, conceived as an individual

behavioral characteristic, to other personality variables. These efforts have not produced evidence of stable relationships between conditionability and various personality factors. Such evidence cannot be expected if conditionability itself is not a stable behavioral tendency, i.e., if there is no consistency of individual differences in the degree to which response preferences change under conditions of reinforcement in a verbal conditioning situation. The purpose of the present study was to determine whether there is a correlation between performance in a verbal conditioning situation on one occasion and performance on a second occasion. The study included an attempt to determine whether consistency of individual differences varies as a function of the number of reinforcements administered in training, and also whether the degree of conditioning attained increases as the number of reinforcements increases. A final purpose of the study was to devise, by empirical item selection, a scale of objective personality test items which would discriminate between individuals with regard to degree of conditionability.

Ninety-nine male Ss were selected from a population of volunteers. All Ss were students in elementary psychology classes, and were between the ages of seventeen and twenty-four.

Arrangements were made for individual interviews with each S. Prior to the interview, S completed the Edwards Personal Preference Schedule, the pool of items selected for the attempt to devise a scale to measure conditionability. In the experimental session, S was shown a series of index cards, each of which had a past tense verb and three pronouns printed on it. It was required that S make up a sentence which included the verb and which started with one of the pronouns. Whenever a particular pronoun was used, E said the word "good" in an unobtrusive way. There were three groups of Ss, representing three different levels of reinforcement; one group received 15 reinforcements, the second group received 30, and the third group received 45. At the end of the first meeting, arrangements were made for a second interview. On this occasion, essentially the same procedure was followed, the main difference being that different pronouns were used on the index cards. At the end of the second meeting S was asked several questions designed to reveal whether he was aware of the contingency between response and reinforcement.

Twenty-nine Ss were discarded from the main analyses because they became aware of the response-reinforcer contingency. The group which received the least number of reinforcements did not show the conditioning effect. The other groups showed a significant increase in the use of the reinforced pronoun. There were no significant differences among groups with regard to degree of conditioning attained, however the differences among groups were in the predicted order. The correlation between conditioning scores for the two occasions was not significant for any group. Because conditionability in this study was not a consistent behavioral characteristic of individual Ss it was not possible to devise a scale to measure it.

Microfilm $2.75; Xerox $3.80. 69 pages.

AN EXAMINATION OF PERCEPTUAL AND COGNITIVE RIGIDITY IN DEAF ADOLESCENT BOYS

(Order No. Mic 61-386)

Martin Henry Wodin, Ph.D.
New York University, 1960

A second listing. For Abstract please see page no. 329.

Microfilm $2.75; Xerox $5.00. 98 pages.

RELIGION

JOHN WESLEY'S ATTITUDE TOWARD WAR: A STUDY OF THE HISTORICAL FORMATION, THE THEOLOGICAL DETERMINATION, AND THE PRACTICAL MANIFESTATION OF JOHN WESLEY'S ATTITUDE TOWARD WAR AND ITS PLACE IN METHODISM.

(Order No. Mic 61-1457)

Egon Walter Gerdes, Ph.D.
Emory University, 1960

Director: Claude H. Thompson

In the introduction (chapter 1) the question of war and the heritage of Methodism is raised. Methodism's position is based upon Christological considerations and is claimed to be its historic position, mediated through Wesley. The literature reveals that this needs to be substantiated.

In the first part, the historical formation of Wesley's attitude, (chapter 2) a study is made of war and the comments of Wesley relative to it. These are occasioned by four periods of war in the eighteenth century: the Jacobite rising, the Seven Years War, the American War of Independence, and its resulting new war with France and Spain. The sources are listed in detail.

The second part, the theological determination of Wesley's attitude, investigates its foundation in the dogmatic concepts of God and man and its explication in the ethical norms for man and society.

As to war and the providence of God (chapter 3), Wesley develops the thesis that God is the God of history. He is the Creator, the Preserver and the Consummator of creation. In His providence He helps man in war and uses war as a means of punishing sin in order to restore peace after repentance.

As to war and the sin of man (chapter 4), Wesley asserts that sin is the cause, content, and consequence of war. It is first shown that sin is indeed the cause of war, that it is essentially the contempt of God, that it is manifest in various vices, expecially pride, and that not only the

enemies or a few countrymen are the guilty sinners, but everyone. Wesley includes himself. It is then demonstrated that war is horror (the emotional argument), insanity (the humanistic argument), and actual and original sin (the theological argument). Finally it is indicated that sin is also the inevitable outcome of war.

As to war and the repentance of man (chapter 5), Wesley interprets war as a call to repentance, and defines repentance as the necessary and proper attitude in war. The form of repentance is fasting and prayer, its purpose the healing and preventing of the evil of war.

As to war and the order of society (chapter 6), Wesley speaks of the state. Its origin is from God whose delegate it is. But a right of war is excluded. The dominion of the state is the act of domination through the king, his sovereignty and the area of the domain, the country. For the king, war can be unavoidable for self-defense, to oppress rebellion. The country is a created organism which should not be divided by war. The citizen of the state stands under the twofold loyalty to God and to king and country.

In the third part, the practical manifestation of Wesley's attitude, (chapter 7) attention is given to war and the conduct of Wesley. He acts within the Methodist societies, within Britain, and from within the first toward the second. He hurries to the Methodists in danger to share their worries. He gives a literary contribution in the fight against rebellion. And he exhorts the Methodists to be loyal, even offering himself their help for defense.

In the conclusion (chapter 8) the significance of war and the obligation of Methodism is pointed out. This is a mediating, bipolar obligation, the witness in the world and the critical evaluation of the own past. The last point concerns above all Wesley's attitude toward war. A short summary of the findings brings, therefore, the investigation to an end. Microfilm $2.75; Xerox $9.25. 205 pages.

OBJECTIVE AND SUBJECTIVE IN KARL BARTH'S DOCTRINE OF RECONCILIATION

(Order No. Mic 60-6692)

Paul Harold Gertmenian, Th.D.
Princeton Theological Seminary, 1960

The purpose of this thesis was to elucidate and evaluate Karl Barth's understanding of the relationship between the Person and Work of Jesus Christ and the appropriation of this work in the life of man, or what has been traditionally described as the relationship between objective and subjective elements in the doctrine of reconciliation.

After a brief historical introduction to this problem, the first part of the thesis examines Barth's solution as developed in volume IV of the Kirchliche Dogmatik. This solution in brief is that reconciliation takes place completely in the life-act of Jesus Christ. Jesus Christ acts in man's place as His representative and because of this all men are reconciled to God and respond to this reconciliation in His humanity, and are thus the recipients of the justification, sanctification and calling that come to the anthropological sphere as a result of His life-act. Every man is ontologically in Christ, but the community and the individual Christian within the community differ from the rest of the world in that the Holy Spirit has awakened them to this reality and empowered them to bear witness as they correspond to it in the acts of faith, love and hope.

The second part of the thesis is an attempt to elucidate certain difficult questions which arise out of this proposed solution of Barth's, in the light of other sections of his dogmatics. Thus his view of sin and evil and the understanding of human freedom consequent upon it, the attempt to derive anthropology from christology, and his doctrine of election in which the understanding of man as having his being ontologically in Jesus Christ has its foundation, are scrutinized in separate chapters. The general conclusions drawn are that Barth tends to deny the reality and seriousness of sin, that he has a paternalistic view of human freedom, that he tends to confuse the orders of creation and reconciliation, refusing to draw a distinction between God's determination concerning man as His creature and the fulfilment of this determination, and that his doctrine of election tends towards a universalism, a mechanistic view of God's relationship to man, and a devaluation of the importance and place of the church.

In the concluding section, an attempt is made to examine the over-all intent of Barth's theological work, and the suggestion is made that Barth is seeking to write a 'total theology,' that he is seeking to do in the realm of theology what Hegel sought to do in philosophy, seeking a key to all knowledge which for Barth takes the form of a purified Supralapsarianism in which reconciliation — the election of Jesus Christ and humanity in Him — is made the primal reality in the light of which all other reality is secondary. Specifically in terms of the problem of this thesis this leads Barth to an insufficient view of man's otherness over against God and of the importance of human history and decision. The suggestion is made that the very means used by God to reconcile man — the Incarnation — rather than minimize or deny these things, actually affirms them, for in that God accomodates Himself to the life of man and encounters man in the man Jesus, man's otherness is affirmed, as well as the importance of human decision, for reconciliation takes place in the gift of forgiveness freely brought by the Incarnate Lord to the life of man and the free response of man to the One who brings God's forgiveness. Microfilm $3.80; Xerox $13.30. 294 pages.

STRUCTURE AND THEOLOGY IN THE FOURTH GOSPEL: A STUDY OF LITERARY FEATURES IN THE FOURTH GOSPEL AND THEIR RELATION TO ITS THEOLOGY.

(Order No. Mic 60-6693)

David Matthew Granskou, Th.D.
Princeton Theological Seminary, 1960

1. Statement of the problem

This study is concerned with the theological and philosophical implications of the literary features of the Fourth Gospel. The problem in this respect is the significance of the ministry of Jesus in the Johannine kerygma. While the earthly ministry of Jesus is still the basic content of the Fourth Gospel, the problem in the history of exegesis has

been the organic relationship between this ministry of Jesus and the unique manner of its presentation in the Fourth Gospel. In general, this problem has been overlooked, or solved by assuming that the unique literary features of the Gospel are evidence of the Fourth Evangelist's lack of concern for the earthly ministry of Jesus. Interest in the Fourth Gospel has therefore generally been for the dogmatic and symbolic implications of isolated passages.

2. Procedure and method

Proceeding from an inductive analysis of the parallels between John and the Synoptics, and also their contrasting vocabulary, the following aspects of the Fourth Gospel are studied in separate chapters: the place of the miracle stories, the function of the dialogue, Old Testament citations, unique words and meanings, characterization, and the aim, literary form, and content of the Johannine kerygma.

The history of exegesis is utilized to specify some of the interpretive problems in the Gospel. The method of approach to the problems is inductive. The aim of the method is to bring out the relation between thought and literary form. The study is therefore a combination of literary criticism and biblical theology.

3. Results

The investigation results in a new understanding of some aspects of Johannine theology and the Fourth Evangelist's literary style. Central to much of the discussion are insights into the relation between history and truth, and the uniqueness of Johannine irony, silence, comment, allusion, juxtaposition, unconscious witness and prophecy, words with double meanings, etc. The recognition of such subtleties necessitates a re-evaluation of the ministry of Jesus and the usual understanding of the Fourth Gospel's symbolism, woodenness, abstractness, etc.

4. Conclusion

The central problem for the Fourth Evangelist was not the teaching of Jesus or a more complete, accurate, or spiritualized account of his ministry, but rather the ultimate authority which he possessed and the manner in which he revealed this authority and glory in his earthly ministry. Only if the ministry of Jesus revealed one who was trustworthy and possessed the power to carry out his purposes in the world could faith in him as the Messiah, and saviour of the world be justified. This study of the literary features of the Gospel points to such a concern and contends that the ministry of Jesus is of primary importance in the Johannine kerygma.

The study is concluded by discussion of the motives of such a concern for authority in the early Christian community, the philosophical and theological implications of such an understanding of the Jesus of history, and the content and literary form of the Johannine kerygma.

Microfilm $4.60; Xerox $16.20. 357 pages.

FIFTY YEARS OF EVANGELICAL MISSIONARY MOVEMENT IN NORTH AFRICA, 1881-1931.

(Order No. Mic 60-6771)

Willy Normann Heggoy, Ph.D.
The Hartford Seminary Foundation, 1960

A second listing. For Abstract please see page no. 238.
Microfilm $5.15; Xerox $18.25. 401 pages.

RELIGIOUS BELIEFS AND SOCIAL STATUS: A STUDY OF THE RELATIONSHIP BETWEEN RELIGIOUS BELIEFS AND SOCIAL STATUS LEVELS IN SIXTY-ONE CHURCHES OF THE SOUTHERN APPALACHIAN MOUNTAINS.

(Order No. Mic 61-1461)

Allen Keith Jackson, Ph.D.
Emory University, 1960

Director: John T. Doby

This study was concerned with the contrasting types of religious belief, supernaturalism and naturalism. Supernaturalism refers to a cluster of closely related religious beliefs which emphasize values that are "otherworldly" in character and are believed to have priority over the normal expectations and values that are culturally approved and esteemed. Supernaturalism includes a strong appeal to a transcendental authority as a sanction of the forms of salvation and "otherworldly" values which are purported to be of primary importance. Naturalism refers to a cluster of beliefs that emphasize "realistic" personal and social goals that are congruent with the secular societal values. There is an appeal to experience, evidence and verified relationships rather than to supernatural authority. There is considerable confidence in man and in his capacity to use reason in solving problems related to human welfare. "Salvation" is interpreted in terms of desirable social goals and psychological states to be achieved by adaptation to processes operative within the natural order.

These types of religious belief were hypothesized to be correlated with different social status levels. Supernaturalism as a belief system was interpreted in part as an emotionally adjustive response to conditions of deprivation and uncertainty, and as a function of limited educational experiences. It was predicted that an increase in naturalism would correlate with an increase in social status. Differences in social status were expected to appear in the organizational characteristics, as well as in the educational and occupational prestige level of the members, of the churches which varied in religious belief.

An Empirical Test. As a part of a descriptive study of religion in the Southern Appalachian Mountains, discussions of religious belief were secured from 61 Protestant churches.[1] These discussions by a group of volunteer members of each church were subjected to content analysis, and were rated on the degree of supernaturalism or naturalism. A number of constructed statements describing

the belief types in regard to 10 theological topics were used to score the discussions from 1 to 5:

1 - Very supernaturalistic
2 - Dominantly supernaturalistic
3 - Mixed supernaturalism and naturalism
4 - Dominantly naturalistic
5 - Very naturalistic

On the basis of the scale scores assigned to the discussions, the 61 churches were ranked into four groups of churches:

High supernaturalism
Low supernaturalism
Low naturalism
High naturalism

The four groups of churches were compared on a number of organizational characteristics. Increase in naturalism was correlated with larger buildings, more organizations, larger average attendance, higher budgets, more full time ministers and more resident ministers. The differences between the extreme groups were consistently significant at standard levels of statistical confidence.

Increase in naturalism also covaried with increase in educational level and with a larger proportion of members in higher prestige occupations. Also within several churches of the same denomination, differences in belief were correlated with the social status levels of the members, where naturalism was associated with higher status.

Social Participation. Some behavioral correlates of the religious belief system were also tested. Members of supernaturalistic churches were less involved in community organizations and were less active in community leadership. There were no differences of significance between the ranked churches in participation in formal church activities, but at the level of informal activities, supernaturalism was correlated with a greater number of religious activities. Supernaturalism was also correlated with the tendency to perceive religious problems, church attendance and the need for "salvation" as the most important community problems.

Some questions for further research on related problems were also suggested which would relate the religious belief types to other social and psychological variables.

1. Southern Appalachian Studies, Earl Brewer, Director of Research in Religion.

Microfilm $2.75; Xerox $8.00. 173 pages.

THE DEVELOPMENT OF DUTCH ANABAPTIST THOUGHT AND PRACTICE FROM 1539-1564

(Order No. Mic 61-262)

William Echard Keeney, Ph.D.
The Hartford Seminary Foundation, 1959

This study examines the Dutch Anabaptist doctrines and practices as they developed between 1539 and 1564. The writings of Menno Simons and Dirk Philips are taken as the major sources. These men were the chief spokesmen during the period. Such a study was needed to assess more fully the movement, particularly as it developed in conflict with the Magisterial Reformation and such representatives of the Radical Reformation as Adam Pastor and David Joris.

The areas examined reflect the particular viewpoint of the Anabaptists. These are: the Scriptures and the ministry; new birth; Incarnation and communion; the life of discipleship; the Church; and eschatology and martyrdom.

The Dutch Anabaptists started with the Scriptures, interpreted from a Christocentric position and primarily known through moral committment. Their views are demonstrated in their understanding of the relationship between the Old and New Testaments, tradition and speculation, and legalism. The Word as a seed was also effective in initiating the Christian life. The minister was the Servant of the Word. Changing attitudes toward the call and ministerial support are noted.

The new birth is a metaphysical transformation by which the believer becomes a partaker of the divine nature. This new creature becomes the dynamic source for the Christian life and is symbolized by baptism. They rejected infant baptism as sacramentarianism or an empty ceremony.

It is shown that a carefully constructed Incarnational formula attempts to solve the Anselmic problem, provide ontological gounds for soteriology and avoid pantheism. Their physiological assumptions were erroneous, but their Christology was orthodox. The importance of the Incarnation for communion is also seen. Their doctrine of the real presence is close to that of Calvin, though they differed some in emphases.

Discipleship was stressed to a degree that led opponents to accuse them unjustly of perfectionism. They did sometimes err in underestimating the power of sin in the believer. The expression of their views on discipleship are reflected in their approach to marriage, church and state, nonresistance, non-swearing of oaths and mutual aid.

The use of Gemeente for the Church as a fellowship instead of Kerk as an organization or institution and the repudiation of the Secten (sects based on heretical teachings) eventually became the integrating principle for doctrine and practice. It was formed by a voluntary separation of believers from the world, with the visible and invisible church in direct but not absolute correspondence. Rigorous discipline maintains the purity of the church through a negative separation of apostates back to the world.

History is involved in a cosmic conflict between good and evil. Therefore believers must anticipate persecution and martyrdom. Dirk Philips' development of this theme gives a sweep and grandeur to the Church which moves from pre-history to post-history. Faith in God's ultimate victory and an eschatological judgment leads the believer to accept martyrdom with hope and joy. The committments in history become eternal after the eschatological judgment.

Certain criticisms of the Dutch Anabaptist position are made as a result of this study. Major ones include some tendency to subjectivism and legalism, theological inconsistencies and a weakness in practical organization. Strengths include the avoidance of strict rationalism, an ontological base for Christian conduct, which is demonstrated practically, and the concept of the Church. The major development discovered was from an emphasis upon personal salvation to the corporate expression of the Christian life in the Church. This shift was most evident in changes regarding the ministry and church discipline.

Some diminishing of eschatological expectations led to modifications of their views concerning the state and the church. Microfilm $4.95; Xerox $17.35. 385 pages.

THE HERMENEUTICS OF PILGRAM MARPECK

(Order No. Mic 60-6694)

William Klassen, Th.D.
Princeton Theological Seminary, 1960

The purpose of this study was to describe the elements in the hermeneutics of one of the outstanding leaders of 16th century Anabaptism. After a brief history of Marpeck studies his life and writings are described. Some writings hitherto known only by title were located in European libraries and used for the first time. Furthermore the use of sixteen letters by Marpeck recently discovered, places Marpeck decidedly in the center of Anabaptism as a leader meriting a thorough study. In the new sources he emerges as a keen churchman who already in 1530 discerned the basic difference between the Anabaptist dissent and that of the spiritualizers. Even Bucer's spiritualizing tendencies were rejected by Marpeck.

An analysis of the basic principles of his hermeneutics indicates his agreement with the wider Reformation on the formal principle, sola scriptura. As a material principle this study suggests "the humanity of Jesus," which Marpeck calls the "key that unlocks the Scriptures." His stress on the humanity of Jesus also forms the basis for his radical differentiation between the Old and New Testaments.

In describing the work of the interpreter Marpeck insists that the presence of the Holy Spirit offers him freedom, not only in seeing the truth of the Bible but also in applying it to the situation in which the church finds itself. The same Holy Spirit works in the church who inspired the writing of the Scriptures. The church is not bound by tradition although Marpeck values tradition because he does not believe that God left the church desolate after the first century. The restraint that is laid upon the interpreter is the Christian community working under the guidance of the Holy Spirit. Marpeck submitted to the judgment of the Christian community and published only two books by himself. The others were composed through group authorship, or "Gemeindetheologie" and the writers invite the reader to correct them so that their testimony may be in accord with God's Word. Marpeck's concept of the Word of God is dynamic. In no sense does he limit the use of that term to the Bible. This point is particularly clear in the discussion of the tension between the spirit and the letter brought about by the deep difference between certain of the Swiss Brethren and Marpeck. A major battle was fought here with Marpeck attempting to prevent Anabaptist biblicism from degenerating into a dead works religion.

A major hermeneutical issue closely related to the problem of the spirit and the letter is the use of the Old Testament. Marpeck used it extensively with certain Old Testament concepts forming important strands in his thought. The covenant, derived from the Old Testament, lies at the basis of all of Marpeck's thought. Furthermore he uses the Old Testament in a devotional way, especially the Psalms and the Songs of Solomon. Allegory is used primarily where the Biblical writers have preceded him in its use, e.g. Songs of Solomon and the Hagar incident. The essential difference between the Old and New Testaments is the event of Christ's coming into history.

A final chapter deals with the various influences that may have gone into the formation of Marpeck's hermeneutics. The mysticism of the Theologia Deutsch and Tauler are evident and he encountered Sebastian Franck, Martin Bucer and Caspar Schwenckfeld of his contemporaries. He rejected the imagery of Melchior Hofmann and the spiritualizing tendencies of Hans Denck. He owes the most to Martin Luther and his efforts at church union indicate he was a true ecumenical reformer.

Microfilm $2.75; Xerox $9.45. 206 pages.

THE COMMUNITY OF FAITH AND THE WORD: AN INQUIRY INTO THE CONCEPT OF THE CHURCH IN CONTEMPORARY LUTHERANISM

(Order No. Mic 61-2217)

Kent S. Knutson, Ph.D.
Columbia University, 1961

The purpose of this thesis is to examine certain concepts of the church in contemporary Lutheranism with the view toward drawing conclusions concerning the natures and causes of the similarities and differences among them.

The thesis is divided into two parts. Part I, entitled ORIGINAL LUTHERANISM AND THE CHURCH, considers the original concepts of the church in Lutheranism as seen in Martin Luther and the Lutheran Confessions, especially the Augsburg Confession. The background and reasons for the contemporary situation in Lutheranism are outlined and documented. Part II, entitled CONTEMPORARY LUTHERANISM AND THE CHURCH, constitutes the principal section of the study and contains four exhibits which delineate the main concepts in contemporary Lutheranism. The view of the Repristination School is represented by Francis Pieper of the United States, and is entitled COETUS ELECTORUM, A SUPERNATURALISTIC CONCEPT OF THE CHURCH. Contemporary Pietism is analyzed through its representative, Ole Hallesby of Norway, under the title, GOD'S FAMILY ON EARTH, A PSYCHOLOGICAL CONCEPT OF THE CHURCH. Lundensian Theology, with Bishop Gustaf Aulen and Bishop Anders Nygren of Sweden as spokesmen, is examined under the title, CORPUS CHRISTI, AN ONTOLOGICAL CONCEPT OF THE CHURCH. Contemporary Neo-Lutheranism or Neo-confessionalism is exhibited by an examination of the works of Edmund Schlink of Germany under the caption, THE PILGRIM PEOPLE, A DYNAMIC CONCEPT OF THE CHURCH.

A short history and general description of the theological position of each type introduces the discussions. Particular emphasis is placed upon the varying views of "Word," faith, and community in each instance.

Four main conclusions are reached in the concluding chapter, which is entitled LUTHERANISM AND THE CHURCH. First: The doctrine of the church is not an exception to the widely recognized judgment that contemporary Lutheranism presents a confused and contradictory

picture of its relationships to its origins. No general statement can be made that Lutheranism holds and teaches Luther's or the Confessions' concept of the church. The four contemporary schools vary widely in their interpretation of their origins. Second: The four contemporary schools exhibit such deep and serious divergencies in their relationships to each other that, despite important ideas which they do hold in common, they cannot be said to explain or define a common concept of the church. They vary from the completely individualistic, with the exclusion of any real community, to the completely communal, with the near exclusion of the individual. The two schools in between begin at different points, one with the individual building toward community and the other holding a basically communal view which at the same time protects the integrity of the individual within it. Third: The causes of the divergencies lie basically, not within the concept of the church itself, but in the prolegomena to the respective theological system, that is, in the view of the Word of God and faith. Lutherans cannot, therefore, deal successfully with the problem of the church by isolating it from the rest of their theology. Fourth: The conclusion should not be drawn that these four concepts of the church are accurately reflected in the life of the Lutheran churches or that Lutherans cannot live together in one church because they do not hold to one common and fully mutually acceptable concept of the church.

Concluding suggestions are made as to the possible open lines of development for the Lutherans in their quest for a common concept of the church.

Microfilm $4.90; Xerox $17.35. 381 pages.

A STUDY OF ATTITUDE CHANGES IN THEOLOGICAL STUDENTS DURING ONE YEAR OF SEMINARY TRAINING

(Order No. Mic 61-2725)

Robert Allen Proctor, Jr., Ed.D.
Temple University, 1961

Major Professor: Dr. James F. Adams

The major purpose of this study was to determine the nature of any changes in attitude, opinion, or belief which might occur among selected theological students during one year of their seminary education for the Christian ministry. Attention was also given to possible correlates of opinion change, especially with regard to educational achievement, certain personality factors, the amount of experience in a church-related vocation, and amount of education.

Method

No suitable instrument was found for measuring theological opinion change among seminary students. To meet this need, a 68-item Theological Opinionaire was developed following basically the method of Thurstone and Chave. Items in the opinionaire were assigned weights of from one to four, along a conservative-liberal continuum. The fourteen most conservative statements (according to judges' ratings) being weighted one, and so on, with the fourteen most liberal statements being given a weight of four. The score on the opinionaire was then computed as the average weight of the statements with which the respondent agreed multiplied by one hundred. Test-retest reliability of the Theological Opinionaire was .89. Two seminaries judged to differ significantly in theological position were chosen. The opinionaire was administered to students in these schools to test its validity. The difference of the means (D_M) for the two groups was 34.81, which gave a t-ratio of 8.59.**

The Theological Opinionaire, the Allport-Vernon Study of Values, and the Gordon Personal Profile were given to 130 selected seminary students in September, 1957. The Theological Opinionaire was administered a second time in May, 1958.

Results

Item analysis.--The t-ratio was used to determine the significance of the difference in the response to individual items on the Theological Opinionaire on the first and second administrations. Twelve items showed a significant shift in response pattern, one toward a more conservative, and eleven toward a more liberal response.

Significance of the difference of the means.--The means for 130 seminary students taking the Theological Opinionaire were 220.500 in September, 1957, and 225.192 in May, 1958. This represented a change of 4.692 toward a less conservative theology and resulted in a t-ratio of 4.105.**

Correlates of opinion change.--No significant correlation was found between change in theological opinionaire and educational achievement as measured by grade-point average.

The Gordon Personal Profile measures four aspects of personality: ascendancy, responsibility, emotional stability, and sociability. Only one of these, emotional stability, was significantly correlated with change in theological opinion, yielding a r of .217.*

Dividing students with parish experience into two groups, one with less than two years' experience and one with more than two years' experience, produced a r_{pbi} of .21.*

Data concerning the correlation between theological opinion change and amount of education were inconclusive.

Conclusions

Curricular experiences seem to be one factor in changes which take place in the theological opinion of seminary students. The emotionally stable person probably feels freer to change his opinion than does the less stable individual. With experience, the seminary student seems to feel more secure in his role as minister and thus is more flexible in his theological opinions.

* Significant at the .05 level of confidence
** Significant at the .01 level of confidence.

Microfilm $2.75; Xerox $7.20. 152 pages.

RELIGIOUS EXPERIENCE IN THE THEOLOGICAL METHOD OF SCHLEIERMACHER, HERRMANN, AND BULTMANN.

(Order No. Mic 61-263)

Toshio Sato, Ph.D.
The Hartford Seminary Foundation, 1959

The intention of this thesis is to examine the role of religious experience in the theological method of Schleiermacher, Herrmann, and Bultmann. A common element to these three theologians is that they understand by faith fides qua creditur rather than fides quae creditur, i.e., they find the realm of faith, not in objectivity, but in subjectivity. Therefore, Schleiermacher emphasizes the concept of feeling, Herrmann emphasizes that of experience (Erleben), and Bultmann emphasizes that of existential understanding.

Schleiermacher defines the essence of religious experience as the feeling of absolute dependence. The feeling of absolute dependence, defined as the essence of religious experience, is the immediate consciousness of what absolutely determines us, i.e., God. Therefore God is present to us before the split into the subject and object. But the feeling of absolute dependence, developed into concrete phenomena, is always combined with the sensible self-consciousness, and thus becomes empirical religious emotion. Christian experience is religious emotion aroused particularly by Christ as the historical revelation. Dogma is the expression of this Christian religious emotion. Dogmatics is an empirical science which describes this Christian religious emotion. The Bible is also the expression of Christian religious emotion, and therefore its normative character is weakened.

Following Schleiermacher, Herrmann emphasizes religion as fides qua creditur, i.e., subjectivity. According to him, there are two kinds of reality: experienceable (erlebbar) reality and demonstrable reality. While science deals with the latter, religion belongs to the former. The content of religious experience is a conviction concerning the power of good over reality. This conviction comes from the spiritual influence of the historical Christ as the historical revelation. But the historical Christ is not the so-called historical Jesus sought by historians. Historical study always leads us to relativity. The historical Christ as the basis of faith is attained by us only in such a way that He breaks through the veils of the Bible, the historical document, and spiritually overpowers us. Therefore the Bible is the medium by which we are led to faith but not the basis of faith.

Like Herrmann, Bultmann distinguishes faith from scientific knowledge. While science seeks objective knowledge, faith is existential understanding. In other words, in faith subjectivity is truth. For Bultmann, therefore, to speak of God is to speak of our existence. Bultmann applies this attitude to historical study. Thus he gives up seeking the exact picture of the historical Jesus, and tries by Dilthey-Heidegger's hermeneutic method to transcend the subject-object relation in historical science and to reduce history to the dimension of existence, i.e., the trans-subjective dimension. At the same time he asserts that this method is the only way to avoid eliminating the character of the New Testament as kerygma but to preserve it. The so-called problem of demythologizing is only one aspect of the application of this method to the New Testament. For demythologizing is not the process of eliminating myth from the New Testament but that of interpreting it.

The theological method of these three theologians is characterized by their effort to distinguish faith from knowledge and to ground faith in subjectivity. Scientific knowledge transforms reality into the "object" detached from the subject. Historical science also transforms history into an object detached from a historian. The three theologians try to transcend such objectification and thereby to meet the challenge of rationalism and historicism. This is their great achievement. But we cannot overlook the fact that as a result they fall into the subjectification of faith, and weaken its cognitive character.

Microfilm $2.85; Xerox $9.90. 217 pages.

THE C.M.S. MISSION OF HELP TO THE SYRIAN CHURCH IN MALABAR, 1816-1840: A STUDY IN PROTESTANT-EASTERN ORTHODOX ENCOUNTER.

(Order No. Mic 60-6772)

Eugene Lester Ten Brink, Ph.D.
The Hartford Seminary Foundation, 1960

A second listing. For Abstract please see page no. 241.
Microfilm $4.60; Xerox $16.20. 357 pages.

A STUDY IN RELIGIOUS PHILOSOPHY OF HIGHER EDUCATION WITH SPECIAL REFERENCE TO THE THEISTIC NATURALISM OF BERNARD EUGENE MELAND AND TO THE BIBLICAL PERSPECTIVE

(Order No. Mic 61-1466)

Charles Walters Whitworth, Ph.D.
Emory University, 1960

Director: William A. Beardslee

This essay explores the theistic naturalism of Bernard Eugene Meland in its implications for philosophy of higher education. The approach to Meland's general philosophical viewpoint is made by showing wherein it absorbs, changes and adds to the stream of philosophical thought flowing from William James, Henri Bergson, Alfred North Whitehead, Charles Hartshorne and Henry Nelson Wieman. The exposition deals specifically with the concepts of religious knowledge, God, man and society. Meland characterizes religious knowledge as "appreciative awareness," God as "Sensitive Nature within nature," man as the "spirit-endowed emergent," and society as an "organic unity of relations."

There follows an examination of the contemporary situation in higher education. Major proposals for the reconstitution of educational theory and practice are typed as Classical Humanist, represented by Robert M. Hutchins; Naturalistic Humanist, represented by Algo D. Henderson

and Harold Taylor (both indebted to John Dewey); Mediating Humanist, represented by the Harvard Report; and Religious Idealist, represented by Robert Ulich. Meland's application of theistic naturalism to higher education emphasizes sensitizing man's "appreciative consciousness."

A critical analysis of aim, content and method in the types of educational philosophy is undertaken by means of the following concepts treated as polar pairs: Personality-Community, Conservation-Change, Arts-Sciences, and Liberalism-Vocationalism. Meland's view contributes a needed religious base for the foundation of higher education but questions are raised concerning adequacy in maintaining the polar elements. Since personality is conceived largely in terms of feeling qualities, there is danger of separation from moral responsibility in community. Since historical events are emergents in an evolutionary process, there is lacking a dialectical view of history to justify conservation and change. Since aesthetic-reflective knowledge is given precedence over scientific-analytical, the way is opened for aestheticism. Since "appreciative awareness" is to be realized in liberal education, the vocational interest receives little attention.

The analysis of Meland's view leads to the questions of ultimacy and certainty in a religious philosophy of higher education. For purposes of comparison, the Biblical perspective is discussed under the same categories used earlier -- religious knowledge, God, man and society -- with the addition of the concept of Christ. Meland's theology deals with general revelation; that of the Bible, with a special revelation. Meland's idea of God leaves out transcendent, absolute and personal qualities found in the Biblical idea. His view of Christ does not maintain the uniqueness and decisiveness of the New Testament picture; and his interpretation of man seems one-sided in comparison with the Biblical interpretation. Society, in Meland's theology, does not require the special community, the Church, for the continuing mediation of God's revelation.

Although the Biblical perspective carries finality only for the person or community grasped by the truth of Heilsgeschichte, it appears to provide more adequate foundation for the polar elements of personality-community, conservation-change, arts-sciences, and liberalism-vocationalism than does Meland's theistic naturalism. The Christian faith does not give ready-made answers for many of the specific problems in higher education, but it offers a context in which the whole enterprise may be related to God's action of judgment and renewal in human history.

Microfilm $4.00; Xerox $13.95. 310 pages.

SOCIAL PSYCHOLOGY

A FACTORIAL ANALYSIS OF PERSONAL-SOCIAL PROBLEM-SOLVING ABILITIES OF HIGH SCHOOL STUDENTS

(Order No. Mic 61-2208)

Abd ELmonim Abu ELnasr, Ph.D.
Columbia University, 1961

The period of adolescence inevitably brings with it problems of a distinctive and critical kind which must be satisfactorily solved, if maturity is to be achieved. Public schools in the United States have considered the development of problem-solving ability as one of their objectives. Senior high schools, in particular, have sought to help students learn how to deal with problems of both a personal and a social nature which they face at school, at home, and in the community. This study was undertaken to isolate mental factors considered important in solving these problems.

Twelve high schools cooperated in giving responses to nine free response problem areas. The reported problems in the nine areas were divided into categories on the basis of frequency of mention. The most frequently mentioned categories were drawn upon in developing items for the problem-solving tests. The tests, developed in terms of nine problem-solving skills, were tried-out, analyzed, and revised. Ten reference tests of five abilities—verbal, numerical, reasoning, perceptual speed, and judgment—were selected. A final administration of problem-solving and reference tests was undertaken in a senior high school during three different mornings, including two testing sessions each. Some tests were scored by IBM scoring machine and others were hand scored. Product moment correlation coefficients among the 20 variables were determined. This 20 x 20 matrix was factor analyzed by the centroid method. Five orthogonal factors were extracted and rotated to simple structure by the quartimax method. Four factors were clearly defined: General Verbal Reasoning, Numerical Reasoning, Perceptual Speed, and Making Relevant Decisions. The fifth factor was difficult to define, since only one test was significantly projected on it. When only five factors were taken into consideration, it was found that many variables had substantial portions of their reliable variance unaccounted for. It must be recognized that the common factors are inadequate to account for performance on verbal tests of skills considered to enter into the solution of personal-social problems. Either the problem-solving tests require specific skills not represented in other tests or the reference tests used were not sufficient to tap the range of common factors.

The problem-solving tests appeared to draw upon two broad common abilities and nine specific abilities. Each of these is presented below.

Common Abilities

1. General Verbal Reasoning. This factor appears to be the ability needed to deal easily with verbal material through understanding the logical relationships involved. This interpretation may define the nature of the problem-solving tasks. Facility in understanding and in discriminating meanings as well as inductive reasoning and understanding of logical relationships are essential in solving personal-social problems presented in verbal form.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

2. Making Relevant Decisions. This factor appears to be the ability to classify specimens according to an established classification scheme. This ability involves deciding whether there is any relationship between ideas, statements, principles and supporting facts on the one hand, and problem situations on the other. The main features of this ability, in addition to the classification of a number of ideas and facts, are: a. deliberation and rational selection, b. weighing of ideas and facts in terms of their relationship to the problem situation, c. application of a criterion explicitly presented or hypothetically assumed, and d. recognition and understanding of all the specified details and facts involved in the problem situation as well as in the relevant data. This factor is considered a clearly defined factor that the present study has isolated for the first time.

With regard to the common broad factors, more research is needed to be sure of the extent to which these abilities can be modified through education.

Specific Abilities

The nine problem-solving tests showed specificity that appeared to define qualities distinct from the dimensions represented in the factor analysis. This suggested that these specific characteristics would need to be added to the common dimensions to provide an adequate basic framework for defining the problem-solving process.

The skills and understandings which seem to contribute to each one of the abilities mentioned above were reported.

Microfilm $2.75; Xerox $8.80. 195 pages.

FRIENDSHIP FORMATION IN TWO ADJACENT INTERRACIAL HOUSING PROJECTS

(Order No. Mic 61-2202)

Daniel Stuart Claster, Ph.D.
Columbia University, 1961

The investigation concerned friendship formation in two adjacent interracial housing projects in New York City, one a low income public housing project, and the other a middle income "cooperative." A sample of 120 dwelling units was drawn at random from the 2930 apartments in the projects. Eighty-eight housewives were interviewed twice, first shortly after most people had moved into the projects, and again about five months later; an additional 21 women could be reached for only one of the two interviews planned. More than two thirds of the respondents were residents of the low income project. Fifty-seven per cent of the low income respondents were Negro, 31 per cent Puerto Rican, and the others were white. Three quarters of middle income respondents were white, one was Oriental and the rest were Negro.

Data were collected on such variables as: feelings about "living here" having made friends, acquaintances, or neither; visits within and outside the projects; and religion, race and nationality characteristics of friends and acquaintances and of people visited. For purposes of this study the comprehensive categories Negro, white, and Puerto Rican were considered the major "race and nationality" groups. Sixty-seven per cent of the respondents said they liked "living here" in the first wave of interviewing, and 65 per cent in the second wave. By the second wave 51 per cent reported having made new friends, and another 33 per cent had new acquaintances. An association between satisfaction with the living circumstances and likelihood of friendship formation was observed, which was not attributable to race and nationality group differences in satisfaction.

About three quarters of the middle income project respondents had new friends or acquaintances different from themselves with respect to race or nationality group in the second interview wave; the proportion for the low income project women was roughly half that for the upper. The difference between projects was explained partly in relation to differential opportunities for contact.

In the second interview wave 25 per cent of the low income project respondents had visited with someone in their own project the previous week; the proportion for the middle income respondents was 45 per cent. Three respondents reported having visited in the project adjacent to their own the week before.

Comparison of respondents who had made friends and those who had not showed having children under age three to be strongly related to formation of new friends, and having children 10 to 17 negatively related to friendship. Also favorable attitudes and perception of neighbors as of the same social class as oneself were related to friendship formation. Economic status, social participation, religion, ethnic group, and education were unrelated to having made new friends.

Among women who reported new friends, those who had children were less likely to have friends different from themselves with respect to race or nationality group than those without children, an association which was not explained away by the greater number of intergroup friendships among middle income, as compared with lower income project women. A significant difference was noted among race and nationality groups in relation to having friends of the same group, or of a different group only: white were more likely to have friends different from themselves, Puerto Ricans least likely, and Negroes intermediate between the two. Favorable attitudes were unrelated to similarity or difference of race or nationality among new friends.

The effect of group and economic status on having friends of the respondents' own or of a different religion was similar to the effect on similarity or difference of friends' groups. There was no difference among the major religions in restrictions of new friends to own religion.

Implications of the findings for public policy in housing were discussed.

Microfilm $2.95; Xerox $10.35. 226 pages.

THE EFFECTS OF SCHOLASTIC SUCCESS AND FAILURE ON THE RELATIONSHIP AMONG SELF-CONCEPT, IDEAL SELF, AND LEVEL OF ASPIRATION.

(Order No. Mic 61-2332)

James Joseph Freer, Ed.D.
Wayne State University, 1960

Adviser: William W. Wattenberg

An investigation involving the "SIQ Q-Sort" and a questionnaire measuring level of aspiration was conducted at the University of Detroit, Detroit, Michigan. 101 freshmen from the College of Arts and Science were used immediately preceding their college entrance and again at mid-term, in an attempt to ascertain the effects of scholastic success and failure on the relationship among self-concepts, ideal self, and level of aspiration.

The major hypothesis was that a person's self-concept remains relatively stable while the ideal self changes in terms of scholastic success and failure. The eight specific hypotheses that were tested, using the null hypotheses, were as follows:

1. "There is not a significant difference between items selected as the self-concept with the 'SIQ Q-Sort' cards in August and at mid-term by subjects designated as failure," was accepted.

2. "There is not a significant difference between items selected as the self-concept with the 'SIQ Q-Sort' cards in August and at mid-term by subjects designated as successful," was accepted.

3. "There is not a significant difference between items selected as the 'ideal' self with the 'SIQ Q-Sort' cards in August and at mid-term by subjects designated as failure," was accepted.

4. "There is not a significant difference between items selected as the 'ideal' self with the 'SIQ Q-Sort,' cards in August and at mid-term by subjects designated as successful," was accepted.

5. "There is not a significant difference between means of the August predicted quality point average based on their Grade Expectancy Pre-College Form and the actual mid-term quality point average for subjects designated as successful," was rejected.

6. "There is not a significant difference between means of the August predicted quality point average based on their Grade Expectancy Pre-College Form and the actual mid-term quality point average for subjects designated as failure," was rejected.

7. "There is not a significant difference between means of the August predicted quality point average based on their Grade Expectancy Pre-College Form and the actual mid-term quality point average for subjects designated as failure," was rejected.

8. "There is not a significant difference between means of the actual mid-term quality point averages and predicted quality point averages for subjects designated as failure, based on an actual grade quality point average and Grade Expectancy College Form," was rejected.

The results of the findings can be summarized as follows:

1. The self-concept is relatively stable. It is more stable for those who met with success than for those who met with failure. Successful persons are more realistic. In that the correlations were significant and the t's were not significant there is an indication that in most instances the same items were placed in the same piles when the subjects sorted and re-sorted the items in terms of self-concept.

2. With the ideal self, the reality of success or failure brought about some type of shift, evidenced by the lack of relationship between the items they selected in August and the items that were selected by them at mid-term. The actual direction or extent of shift was not within the limits of this dissertation, but offers possibility for further research in this area.

3. In terms of prediction, lack of significance (with one exception) in the coefficients would indicate that the relationship between their levels of aspiration and the actual grades for both successes and failures is not related. However, the results indicated a very slight degree of relationship between the predicted grades and the actual grades for successful persons while showing no indication of such relationship for the failures.

4. Subjects' predictions in August of quality point averages were higher than the actual grades received at mid-term; their further predictions, following the receipt of mid-term grades, were again higher than the actual grades. This was true of both successes and failures, but more so with regard to the failures.

5. It appeared that with the successes some self-objectivity was involved. At least it seemed that the subjects were being more practical after having seen what they could accomplish in terms of college grades.

Microfilm $2.75; Xerox $4.20. 78 pages.

MEANING INTENSITY AS RELATED TO READERSHIP OF FOREIGN NEWS

(Order No. Mic 61-2703)

John Taylor McNelly, Ph.D.
Michigan State University, 1961

Major Professor: Paul J. Deutschmann

This investigation grew out of the question of whether mass media messages can influence audience interests, particularly in the field of foreign news.

The general question has stirred much speculation among critics, practitioners and researchers of the media. Empirical evidence in this area, however, is relatively sparse. Psychological and media researchers have tended to equate interest with "liking." This study sought rather to measure interest as a readiness to pay attention and to determine whether it can be affected by foreign news stories.

The theoretical rationale for the study centered around the development of meaning, through associational processes, of what Osgood calls "assigns" or "sign-assigns." Osgood's semantic differential has been useful in research on assign development. A number of experimental studies were cited which suggest an underlying relationship among polarization on semantic differential scales, meaningfulness, attitude intensity, perceptual facilitation, and expressed interest.

An index of meaning intensity was constructed to

measure interest; it was composed of degree of polarization on evaluative scales of the semantic differential, plus absolute scores on potency and activity scales.

Two experiments were performed, in which the stimulus materials were printed news stories about eight foreign news topics of low familiarity. Testing materials included semantic differential scales and a forced-choice headline test. Subjects for the first experiment were 104 high school students; for the second experiment the subjects were 126 university summer session students of a broad age range. Variations were introduced in the design of the two experiments in order to obtain data on number of exposures and on retention.

The results supported the hypotheses. (1) Exposure to news stories about the topics resulted in increased meaning intensity for them. (2) Increases in meaning intensity were accompanied by increases in expressed interest. (3) Increases in meaning intensity were accompanied by the probability, as indexed by headline choices, of further readership about the topics.

Data on number of exposures and retention were somewhat suggestive of negatively accelerated curves of learning and forgetting for meaning intensity. The retention data indicated that, while forgetting did set in, some acquired meaning intensity was retained in the days immediately following exposure to the news stories.

Meaning intensity levels for exposed groups were not changed significantly by attempted manipulations of evaluative polarization, potency and activity in individual story versions in the first experiment. However, separate analysis of data on these three components in the second experiment provided support for their inclusion in the meaning intensity index.

Exposure to the news stories resulted in the hypothesized effects for topics which were unfavorably evaluated, as well as those which were evaluated favorably; "liking" was not a necessary condition for interest.

The results of the experiments were discussed in terms of their theoretical, practical and social implications. Conclusions were drawn on relationships between meaning intensity, or interest, and exposure to news stories. Further research was suggested, particularly through field experimentation to obtain evidence on media effects on interests in natural settings.

Microfilm $2.75; Xerox $6.40. 133 pages.

PARENTAL RECALL OF ASPECTS OF CHILD DEVELOPMENT AND OF CHILD-REARING PRACTICES

(Order No. Mic 61-2651)

Lillian Cukier Robbins, Ph.D.
New York University, 1961

Adviser: Elsa E. Robinson

The present study has examined the accuracy of parental recall for various aspects of child development, by comparing retrospective accounts of child-rearing obtained from parents of three-year-olds, with reports they previously gave in the course of a longitudinal study begun with the birth of the child.

The subjects were well-educated members of the middle-class living in New York City and its nearby suburbs. Thirty-nine couples, plus five mothers whose husbands were divorced or otherwise unavailable, were interviewed. The memory questions were embedded in a lengthy interview on parental practices and attitudes. One parent was interviewed by the author and the other by her husband, a psychiatrist, the two interviews being carried out at the same time, but in separate rooms.

The major findings are as follows:

1. The parents are quite inaccurate in their memory of details about child-rearing practices and early developmental progress, in spite of the frequent rehersal of these data due to their participation in the longitudinal study, and in spite of the relatively young age of the children. Inaccuracies are greatest for items concerning the age of weaning and toilet-training, the occurrence of thumb-sucking, and whether the child was fed on schedule or demand.

2. Inaccuracies tend to be in the direction of the recommendations of experts in child-rearing, especially on the part of the mothers.

3. Mothers recall more correctly than fathers, significantly so for quantitative items, that is, those dealing primarily with when events occurred.

4. Mothers who stay at home or work only part-time recall quantitative items somewhat more accurately than mothers who work full-time. However, the latter are significantly better in their recall of qualitative items, that is, those dealing with whether certain behaviors have occurred.

Fathers who participate greatly in child care recall quantitative items more accurately than those who participate less. However, their recall is inferior on the qualitative items. These differences were not statistically significant, though the former approaches significance.

5. Mothers of boys tend to recall more accurately than mothers of girls. Fathers of boys tend to recall qualitative items more accurately than fathers of girls. However, they are poorer, to an almost significant degree, in their recall of quantitative items.

6. Similarity of sex between respondent and interviewer is conducive to better recall, especially for fathers, who recall quantitative items significantly more accurately in talking with the male than with the female interviewer.

7. Mothers of one child tend to recall better than mothers of two or more children. Fathers of one child recall quantitative items significantly less accurately than fathers who have more than one child, though they are somewhat more correct for the qualitative items.

8. Mothers whose three-year-old is an "older" child tend to recall more accurately than mothers of "younger" children of the same age. Fathers of an "older" child recall quantitative items the most accurately, and fathers of an only child, the least. For qualitative items, the recall of fathers of only children is slightly superior, and that of fathers of "younger" children, the poorest.

The accuracy of data obtained by other investigators who have relied on retrospective reports was questioned in the light of these findings. The results were discussed in terms of their bearing on the study of the relationship between child-rearing practices and personality development. Microfilm $3.00; Xerox $10.35. 230 pages.

SOCIOLOGY, GENERAL

VOLUNTEER AND STAFF PARTICIPATION IN A VOLUNTARY SOCIAL WELFARE ASSOCIATION IN THE UNITED STATES: A STUDY OF THE NATIONAL YOUNG WOMEN'S CHRISTIAN ASSOCIATION.

(Order No. Mic 61-2207)

Angelina Carunungan Almanzor, D.S.W.
Columbia University, 1961

A distinct trend in the historical development of the social work profession is the increasingly widespread acceptance of the belief that the survival and sustenance of the complex pattern of social welfare organizations depends upon the participation of an informed and active volunteer membership, and the utilization of the knowledge and skill of a trained and competent staff. Stressing this partnership concept, voluntary associations – such as the National YWCA – have relied on volunteer and staff participation in the planning and discharge of their varied programs and services. This research is a beginning attempt to compile empirical evidence which have a bearing on the phenomenon of volunteer and staff participation in the National YWCA.

The theoretical perspectives of this study were based upon the following hypotheses: –

(1) Many of the essential characteristics of organizations stem from the social character of their membership as well as the satisfactions (and/or dissatisfactions) which individuals derive from their participation.

(2) The nature of participation is influenced by the bureaucratic requirements of formal organizations.

Since the major focus of this study was on participation (that which referred to more than just nominal membership), we examined data on the differences in age, marital status, religion, value-orientation, socio-economic status, motivation, and role-perception of the volunteers and staff workers which affected their participatory behavior. Furthermore, we studied the organizational policies instituted by the Association which had the effects of minimizing conflicts and maximizing the cooperative and satisfying participatory experience of volunteers and staff workers.

The sample population consisted of all those volunteers and staff workers who belonged to an actual committee group working on a specific project – the Eastern Regional Conference.

The study revealed a high level of correlation in the social characteristics of volunteers and staff workers. The only significant difference noted was on marital status. Most of the staff workers were single whereas a great majority of the volunteers were married. These findings dispelled the myth that stresses and strains in volunteer and staff participation frequently arose because of their dissimilar backgrounds.

The criteria for measuring participation vary, but in this research we used certain commonly accepted indices – namely, continuing involvement in program activities, holding offices, attending meetings, and voting in elections – all of which were encompassed in an over-all category termed "tenure of participation"; and, to some extent, the qualitative index of sustaining the two-way flow of communication between volunteers and staff workers, thereby maintaining harmonious working relationships.

Finally, by presenting an interpretative analysis of the correlates of participation, we indicated the trends in and possible implications of the role relationships between volunteers and staff workers. The following conclusions emerged: – Participation was enhanced by those factors which made for greater identification with one's occupational situation and occupational community, and diminished by those influences which fostered contrary orientations. The modes of interpersonal influences, the normative dispositions, the nature of the job, the stability of the work force, and the orientations toward work life and work mates comprised the elements which determined that identification. Participation was a result of the acceptance of work, work place, and work mates as constituting a meaningful part of the participant's life, as well as providing a legitimized means for attaining familial, religious, social, and occupational aspirations. Thus, the findings reported in this study were clearly illustrative of the trends toward continued and effective participation in the YWCA.

Microfilm $2.95; Xerox $10.35. 226 pages.

THE PATTERN OF COMMUNITY LEADERSHIP IN URBAN REDEVELOPMENT: A PITTSBURGH PROFILE.

(Order No. Mic 61-1855)

Arnold J. Auerbach, Ph.D.
University of Pittsburgh, 1961

The accomplishments in Pittsburgh's urban redevelopment, achieved primarily through the efforts and activities of a top section of the city's business and industrial leadership, present a graphic opportunity for studying, within this context, some facets of community power, and the exercise of power by a leadership group in one of America's most industrial of cities.

Members of the Executive Committee of the Allegheny Conference on Community Development, all top leaders in the business and industrial life of the city, are generally credited with being the originators and the driving force behind the spectacular accomplishments in urban renewal.

What were the motivations of these men involved in the

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

rebuilding of their city? How were unity and cooperation attained? How were these leaders chosen and how did they exercise their power? From where did they derive their authority? What controls existed to keep their power within the bounds of community interest? What implications may be drawn from their activity for a clearer understanding of the role of modern corporation executives in a democratic society?

By the use of objective information derived from various sources, a profile was drawn of the top twenty-five business and industrial leaders in the Allegheny Conference indicating their ages, places of birth, whether business owners or employed managers, education, religious affiliations, places of residence, occupations, civic interests, social and country club memberships, and their political affiliations.

Personal interviews were conducted with sixteen of the twenty-five community leaders and with the Governor of the State of Pennsylvania regarding their attitudes toward community leadership, civic interests, social institutions, power limitations, the leadership of Richard K. Mellon, internal conflicts, politics, labor, and professionals.

The study revealed that as a group, the members of the Pittsburgh "power elite" are closely related to their racial, religious, ethnic and social backgrounds, and are closely allied in their economic, social, and civic interests. But their differences are by no means foreign to the level of understanding and acceptance of the general community and are, indeed, on some levels of civic and community activity well within the working orbit of other classes of the population.

In the urban redevelopment of Pittsburgh in 1960, there has been a certain equilibrium attained through the relationship of interests, groups, and forces which developed a convergence of interests of the business and industry leadership and the general population. The interests of both have demanded a clean city, an honest government, better housing, an efficient school system, good recreation facilities, and expanded cultural institutions. The community leadership has often employed manipulative rather than democratic processes, has sometimes overlooked the necessity of involving other sections of the population in the decision-making processes, and their general attitude to the community has been a "paternalistic" one. Yet the "power elite" of Pittsburgh, motivated chiefly by their desire to sustain and increase business profits by attracting and holding new industry and recruiting business managers, scientists, research specialists, and a stable laboring force, has succeeded in bringing about dramatic changes which have benefited all the residents of the city.

Decisive factors in the success of Pittsburgh's "Renaissance" have been the personal leadership of Richard K. Mellon, the cordial working alliance between Republican business and Democratic political leadership, and the strict adherence to a code that urban renewal projects must not be dictated by desire for individual gain or political patronage.

Microfilm $2.75; Xerox $6.60. 139 pages.

A STUDY OF THE DIVERSITY OF ROLE EXPECTATIONS OF THE POSITION SOCIAL WORKER: AMONG PROFESSIONALLY TRAINED SOCIAL WORKERS IN SYRACUSE, NEW YORK.

(Order No. Mic 61-1485)

Jerome Cohen, D.S.S.
Syracuse University, 1960

Supervisor: Kenneth W. Kindelsperger

This is an exploratory study; a broad description of the manifest content of responses to questions relating to role expectations of the position social worker as elicited from incumbents of that position in Syracuse, New York. It proposes to make explicit, in the words of the social workers themselves, the activities they feel their profession encompasses. The study was designed to discover the range of these role expectations so that a more highly structured role analysis might be made in the future.

The sample was drawn from a universe of professionally trained social workers employed in the City of Syracuse, New York. The total universe numbered 88 social workers. From this 88, a simple random sample of 25 was selected. The sample is highly representative of the total universe insofar as certain known major attributes are concerned.

The study consists of field interviews of the 25 respondents in the sample. In order to insure at least minimum comparability of the responses a standardized interview schedule composed of open ended questions was used rather than a non-structured interview. Each major question had one or more subquestions to be used as probes in the event that the spontaneous response to the major question did not contain the information sought. The schedule included 19 major questions covering a wide range of activities of social work thought and practice. The questions were developed from a survey of the social work literature and consultation with social work and social science colleagues.

The manifest content of the interviews was the subject of analysis. Throughout the analysis a broad classification system was maintained which utilized the actual words of the respondents to describe a specific attribute, problem or function.

The findings demonstrate that there is a small core of role expectations held in common by the respondents, but also a considerable number of differences. Of the total of 196 categories of response delineated in the content analysis, 52 categories of response were shared in common by 13 (52 per cent) or more of the sample population. When we sought agreement at a base of 18 (72 per cent) of the sample population, we found only 24 categories of response held in common. These 24 categories represented the core of agreement among the respondents. The remaining 172 categories of response represent the wider parameters as seen by smaller groups of the respondents. Both in the individual interviews and in the group data conflict and ambiguity regarding role expectations were found. The most frequent area of conflict was in regard to the need for graduate training in a school of social work as a prerequisite for engaging in social work practice. A degree of uncertainty existed as to who shall be called a social worker. The title social worker was used both when

referring to graduates of schools of social work and to those practicing in social agencies without such degrees. Conflict was also found in regard to issues concerning some trends in current social work literature such as the "generic" concept and the plea for a greater concern for broad social planning and social action. Finally, we found that much of the diversity of response arises out of the minutiae of detail which the respondents utilized to describe social work practice in place of a more general conceptual approach.

Microfilm $2.75; Xerox $9.70. 211 pages.

THE OCCUPATIONAL AND GEOGRAPHICAL DISTRIBUTION OF SMALL TOWN MISSOURI HIGH SCHOOL STUDENTS: A PILOT STUDY.

(Order No. Mic 60-6807)

Joseph Turner Howard, Ph.D.
University of Missouri, 1960

Supervisor: Dr. C. E. Lively

This study was made for the purpose of setting up a design for subsequent state-wide studies investigating the occupational and geographical distribution of Missouri male high school students. The more ultimate purpose of this information was to supply data for a study of employment opportunities for redundant rural population in Missouri. The field research for this study was done by selecting three small towns in Missouri and drawing a sample by cohorts from their high school records. Direct-mail questionnaires were sent to those on a "master mailing list." The returns were coded and analysis was made of the data on a descriptive basis. The three towns and the five cohorts were used throughout the study as independent variables. All other data taken from the schedules served as dependent variables and comparisons were made in that manner.

The theoretical setting for the study was taken as the social systems theory, especially as it is found in the concept of the rural social systems. The respondents in the study were taken to be products of the social systems in which they received their formal education, especially at the high school level, as no one was included in the study unless he had at least enrolled in the ninth grade and attended long enough to be a matter of record.

The conclusions drawn from the study are tentative in nature and are not stated as final but as "tending" to support some of the general hypotheses set forth in detail in the discussion. Statistical verification of the various hypotheses and of other findings in the study is assumed to be more logically based on the state-wide study which this design presupposes.

The design, in the main, yielded the anticipated results in terms of returns and usable responses to the questions in the schedule. Where obvious deficiencies appeared, recommendations were made for revision of the survey document. Information secured through the use of the revised schedule should provide data which could be made the basis of a record of past geographical and occupational movements of small town Missouri males and of predictions as to the general patterns of their movements in the future.

The study provides some insight into the patterns of occupational and geographical distribution which might be found in a state-wide study. It gives detailed bibliographical material for use in preparation for additional research in this field. In addition, it provides a vehicle for research in occupational and geographical mobility which gives a depth in time not ordinarily found in such studies. A "Personal Work Record" makes it possible to trace the movements of the respondents up and down the occupational ladder over a period of time and at stated intervals. It also provides information on spatial mobility during the same time span. Comparison of these two major sociological phenomena gives a knowledge of important and necessary information. Such data are useful to the educator, the employer, the employee, and the social planner.

A key to providing better employment opportunities for surplus rural population in Missouri is to have detailed data on movement patterns in the work world. This pilot study has sought to provide some of the tools necessary in the construction of that key.

Microfilm $5.55; Xerox $19.80. 436 pages.

CRIMINAL HOMICIDE (A STUDY IN CULTURE CONFLICT)

(Order No. Mic 60-3661)

C. H. S. Jayewardene, Ph.D.
University of Pennsylvania, 1960

Supervisor: Professor Marvin Wolfgang

The basic hypothesis of this study is that criminal homicide is an expression of culture conflict. The problem has been conceptualised in terms of values. The individual's behaviour, it has been assumed, can be interpreted in terms of values and culture conflict viewed as an expression of the difference between the values an individual has internalised and the values the politically dominant group would have him internalise. The conflict is not viewed as an absolute conflict although the values may be antithetical. It is viewed rather as a relative conflict due to differential stress on the same value. Values are conceived as being arranged in a value configuration where each value has its own normative power governing both the dictation of behavioural norms and the frequency of behaviour conforming to or deviating from these dictates. The values internalised by individuals in society are epitomized in the societal value system and the values that the politically dominant group would have him internalise in the legal value system.

For the purposes of this study several indices using demographic data have been devised: an index for the normative power of the value of human life, a conflict index, an index of cultural heterogeneity and an index of cultural integration. The conflict index has been correlated with the volume of criminal homicide to test the thesis that criminal homicide is an expression of culture conflict. Data from Ceylon and Finland have been used. Considered as separate units both Ceylon and Finland support this hypothesis. So do the different provinces in

Finland when considered individually. Some provinces in Ceylon however, fail to support the hypothesis. Of a total of nineteen correlations fourteen support the hypothesis.

The social and cultural conditions in Ceylon and Finland have been examined to demonstrate a. the existence of a variety of groups with different value systems that endow the value of human life with different normative powers in each country; and b. the volume of criminal homicide relative to variations of the cultural heterogeneity of society. The index of cultural integration has been correlated with change in homicide rates to test the thesis that cultural integration is associated with a reduction in criminal homicide and cultural diversification with an increase in criminal homicide. The data from Ceylon and Finland support this hypothesis.

In addition, certain problems germaine to the study of criminal homicide has been examined.

First, various homicide rates have been examined with the conclusion that while vital statistics provide a valid index of the extent of general criminal and non-criminal homicide in a country, police statistics provide the best index of criminal homicide.

Second, the error introduced by the use of the total population of a country instead of the population committing homicide, empirically established as the 10-60 years age group, in the computation of homicide rates has been examined. In a study investigating homicide over a period of time in one country no appreciable error appears to be introduced by such a procedure.

Third, the influence on homicide rates of improvements in medical technology has been examined. Though the data do not support the view that reduction in the homicide rate is due primarily to these improvements, the evidence suggests that they do play some part.

Microfilm $4.40; Xerox $15.55. 344 pages.

A SITUATIONAL ANALYSIS OF THE EFFECTS OF DROUTH AS A DISASTER ON THE MOBILITY OF A SELECTED RURAL-FARM POPULATION

(Order No. Mic 61-2125)

Clarence Willard Ketch, Ph.D.
Louisiana State University, 1961

Supervisor: Professor Alvin L. Bertrand

It has been commonly assumed that drouth motivated farm operators to make certain changes, but little empirical basis exists for the assumption. The present study is an effort to understand the role of drouth in the lives of farm operators and their household members and to determine the nature and extent of changes made. It centers on a drouth-stricken rural-farm area, and the effects of drouth are described in terms of behavioral changes made by the affected population.

The study is substantive in design and consists primarily of statistical material. A situational frame of reference is used in the analysis of the data collected. The situation is construed as the presence of general conditions of serious and prolonged drouth.

Data for the study were obtained from personal interviews. The sample population consisted of all of the residents of each of three selected census precincts in Mills County, Texas. All migrants who could be located within a 60-mile radius of the study area and who had migrated from there between 1950 and 1958 were also interviewed. Altogether, 879 persons were interviewed. The data were coded, verified, and tabulated using a machine process. Supplementary information was obtained from secondary sources such as the United States Census.

The important findings of the study are as follows:

Drouth is not associated with migration to the extent commonly assumed. However, dry-land farmers move more frequently in times of drouth than do ranchers. Persons moving because of drouth do not find migration a satisfactory adjustment. Migrants from drouth areas tend to have the same general characteristics of age, sex, and education as do migrants generally.

Drouth is associated with many behavioral changes in rural places other than migration. In the study area, changes were made in farming practices, such as type of crops planted, amount of acreage planted, and kind of livestock raised. Drouth also brought changes in such practices as off-farm work and in use made of farm agencies. Drouth was also positively related to changes in the use of programs such as the Soil Bank Programs and the Federal Drouth Relief Program. Most changes, other than migration, made for drouth reasons were interpreted as beneficial to the drouth situation.

The over-all conclusion of the study is that empirical research is needed to establish whether or not drouth represents a unique and crisis experience to the residents of a particular area. When drouth is interpreted as a crisis, migration is likely to occur. However, when the situation is interpreted as an experience that is not unique and for which relatively temporary changes will suffice, migration does not occur. Temporary changes will generally involve reorganization of farming policies.

Microfilm $3.80; Xerox $13.30. 295 pages.

STATUS INCONSISTENCY: SPECIFICATION OF A THEORY.

(Order No. Mic 61-2223)

Robert Sokol, Ph.D.
Columbia University, 1961

The theory of status consistency states that if ranked-statuses are not relatively equal there will be efforts to "equilibrate" them. If these efforts are inhibited the consequent strains will be expressed either in social withdrawal or in leftist or liberal ideology. The plan of this dissertation is to specify conditions under which status inconsistency would be more or less felt, specify responses to inconsistency in more detail, and incidentally to replicate prior empirical studies of status inconsistency.

The study is based on a survey of a random sample of Winchester, Massachusetts, in the spring of 1958. Winchester is an upper-middle class "bedroom" suburb of Boston, about equally Protestant and Catholic and with substantial proportions of Irish and Italian ethnics. The analysis deals principally with 281 males, 150 of whom

were obtained in a special, stratified random sample in which status inconsistents were over-represented. The average interview lasted 1 1/2 hours.

An index of gross status inconsistency--of ethnic, occupational, education, and income statuses--is constructed in a way comparable with previous investigations, most importantly that of Lenski. Gross status inconsistency, however, fails to produce the effects observed in the earlier studies on the following dependent variables: party preference; welfare-liberalism; McCarthyism; desire for change in the national power structure; sociability; and mobility-orientation. (In all the analysis mean status level, i.e., SES, is held constant.) This is true even after several specifying conditions are introduced: (a) perception of and concern about one's inconsistent status-set; (b) attachment to Winchester; (c) an attitude preferring consistent statuses; (d) class consciousness; (e) susceptibility to strain from social interaction; (f) intolerance of ambiguity; and (g) upward mobility-orientation. Although there were some facilitating effects, these effects were spotty.

Several possible reasons for the failure to replicate previous results are considered, the most important being that specific inconsistent pairs of statuses have effects that cancel the effects of other pairs, i.e., inconsistent status-pairs do not all have effects in the same direction. An investigation pair by pair, with SES held constant, shows that among lower SES inconsistents, those whose high status is an achieved status simply respond as if they are tending towards the consistents of higher status--they are more Republican, more welfare-conservative, less pro-McCarthy, and more in favor of change in the power structure. They are not different from lower SES consistents in mobility-orientation. Those lower SES inconsistents whose high status is ascribed (ethnicity), are more pro-McCarthy, more in favor of shifts in the power structure, more sociable, and more mobility-oriented than the corresponding consistents.

Among higher SES inconsistents, those whose ethnicity is lower than their achieved statuses are more pro-welfare, less mobility-oriented, and in two of three comparisons more Democratic than the relevant consistents. Those whose occupation is lower than their other statuses, are more pro-McCarthy, more in favor of change in the power structure, less sociable, and in two of three comparisons less pro-welfare. Those whose education is the discrepant low status and whose occupation and income are the higher status are strongly Republican and welfare-conservative, more sociable, and more mobility-oriented than consistents. Where education is low and ethnicity high, however, inconsistents are more pro-welfare, more pro-McCarthy, and more in favor of change in the power structure. Where education is high and income low, inconsistents are less pro-McCarthy, more in favor of change in the power structure, more sociable, and more mobility-oriented than the corresponding consistents. The remaining pairs with low income produce no pattern of differences. Thus, only Goffman's "desire for change in the power structure," which is a contentless measure because different types of inconsistents see different groups in power, correlates with virtually all types of paired-inconsistency. All other dependent variables depend on specific types of inconsistency. Microfilm $3.55; Xerox $12.60. 276 pages.

HOMOGENEITY OF FIRST DEGREE HOMICIDE CASES AS REVEALED BY INSTITUTIONAL CHARACTERISTICS

(Order No. Mic 61-1890)

Charles M. Unkovic, Ph.D.
University of Pittsburgh, 1961

The literature relating to first degree homicide offenders serving life sentences discloses a consistent trend to regard these prisoners as a homogeneous group and somewhat apart in nature and habit from the general inmate populations of our penal institutions. Within the prison society no legal group would be expected to have more inclinations to form social groups or display a group opinion than would the life-termers. They share a common sentence and crime, and are, by all means, a relatively permanent part of the prison community. This belief, however, has not been subjected to empirical proof. Although the "lifers" have been tested and re-tested, their homogeneity has been, apparently, taken for granted.

Accordingly, the hypothesis that evolved was that first degree homocide cases serving life sentences in a maximum security prison are a homogeneous group as indicated by acquired institutional characteristics. Subjects for the present study were male adult felons incarcerated at the State Correctional Institution at Pittsburgh, Pennsylvania. This is a maximum security institution which houses approximately 1100 inmates. One hundred forty of this number are inmates serving life sentences for first degree homicide. Sixty cases were observed and studied to determine the validity of the hypothesis. The study group consisted of thirty life-termers and the control group of thirty other long-term offenders.

Donald Clemmer's social relation questionnaire was utilized to test the hypothesis. It was devised by Clemmer after much intensive field research and is the basis for one of the most outstanding texts on prison life. This particular questionnaire is designed to probe the social relations of the inmate in the prison community. The measure is concerned with ratings of self and others in a questionnaire of thirty-three inquiries. Since there was no appropriate answer guide available, the significance and consistency of the answers were measured by the use of frequency tables, percentages and other social research techniques. This was, also, supplemented by an explanation concerning the rationale of the various replies.

The "we-feeling" or evidence of homogeneity was the phenomenon searched for in the present study. After the data were interpreted, however, there was little evidence to support the hypothesis. Careful scrutiny of the data revealed that there were instances where the "lifers" tended to act as members of a category, but there were more instances where there did not appear to be any major difference in the opinion of the study and control groups. Although some indications in support of the hypothesis were observed, the import of these indications was of little consequence. For example, in the area of prison friendships the strongest supporting indications were observed, and yet, in further pursuit of this revelation we found that there were certain obvious factors operating which would almost dictate that the life-termers tend to be more cautious in forming friendships. In a broader interpretation, it might be stated that the life-termers do not reflect their "true" attitudes in regard to friendships, but reflect the prohibitions that are placed upon them.

Although the hypothesis was not substantiated by the findings of the investigation, a number of areas for further research were suggested by the data, including the development of a more efficient measure, the difference in attitudes between various criminal categories, the fact that the criminal code is only operative in the primary group, and a realization that there appears to be little discernible difference in the attitudes of life-termers and other long-term offenders.

According to this study, the "lifer" is a legal rather than a sociological category.

Microfilm $2.75; Xerox $4.80. 92 pages.

RELIGION AND SOCIAL MOBILITY IN INDUSTRIAL SOCIETY

(Order No. Mic 61-2805)

Neil Jack Weller, Ph.D.
University of Michigan, 1961

This study investigates comparative rates of vertical mobility among Catholics and Protestants. The objective is to appraise the effects of religious values upon social mobility in contemporary American urban-industrial society. On this question, current theories conflict, and empirical evidence is both inadequate and contradictory.

The research focuses on these issues: (1) Catholic-Protestant differences in intergenerational occupational, income, and educational mobility; (2) the strata, both of origin and destination, which constitute the loci of these differences; (3) the significance of differential life-chances and structural rigidity in the occupational system itself for the magnitude of religious differences; (4) the implications of the findings for assessing the character of current social trends in America.

Through the facilities of the Detroit Area Study, a cross-sectional probability sample (1177 cases) of Catholics and Protestants in the Detroit metropolitan area was studied. In order to standardize life-chances and socialization experience, the population was restricted to white males, currently employed, who were raised within a northern-urban-American community. Education, ethnicity, occupational destination, income, and age were controlled in specific contexts. All results summarized below deal with patterns uncovered when father's occupation is held constant.

The findings indicate that Protestants excel in income and, especially, occupational mobility--notably, in achieving upper white collar status and earnings in excess of $10,000. Catholics are more downwardly mobile, particularly in multiple step descent to the lower blue collar stratum. Within occupational destination strata, Protestants surpass Catholics in income. Protestants generally exceed Catholics in education. Most noteworthy are religious differences in rates of college graduates and high-school drop-outs. When education is controlled, Protestants still outdistance Catholics in economic success. Ethnicity is neither strongly nor consistently related to mobility differentials either within or between religious groups. Age is inversely related to the Protestant advantage in vertical mobility, especially for education. In general, religious differences in vertical mobility are concentrated in the highest and lowest destination strata and are larger among workers of white collar origin than blue collar origin. Protestants appear to excel, in particular, in mobility patterns which suggest high achievement orientation and which require traits traditionally associated with the Protestant ethic--for example, extreme upward mobility and deferred gratification.

Protestant-Catholic differences are sufficiently consistent in pattern and pronounced in scope to conclude that there is a significant relationship between religion and social mobility in Detroit. Based upon analyses of patterns of religious differences in mobility achievement under pertinent sets of simultaneous controls, the following tentative conclusions emerge: (1) that is no current trend toward increasing Catholic equality in social mobility; (2) religious-ethnic discrimination is not a significant obstacle blocking economic achievement for Catholics; (3) Protestants are more highly motivated to achieve educational and economic success; (4) the margin of Protestant superiority is directly related to economic prosperity and fluidity in the occupational structure.

It is hypothesized that self-contained religious subcommunities and religious differences in class identification (or reference-group orientation) within stratum of origin are two major factors that facilitate the development of dissimilar mobility aspirations and achievement between Catholics and Protestants.

The evidence militates against theories of social change which stress the devaluation of achievement and work, the decline of mobility opportunities, the rise to supremacy of the "social ethic" over the Protestant ethic, and the homogenization of character structure and values among the urban masses, in America during the last century. In respect to religion, the findings indicate that the success ethic is internalized in greater measure by workers of Protestant persuasion, bearing witness to the current relevancy of the "Weberian thesis" in Detroit.

Microfilm $3.10; Xerox $10.80. 239 pages.

SOCIOLOGY, FAMILY

CONTENT ANALYSIS OF MIDDLE CLASS WOMEN'S FICTION FROM 1901 TO 1960 AS INDICATIVE OF CHANGING CULTURAL VALUES RELATED TO MIDDLE CLASS BIRTHRATES

(Order No. Mic 61-2508)

Eugene Vernest Smith, Ph.D.
Purdue University, 1961

Major Professor: Walter Hirsch

The Problem. Our objective was to help explain the fertility fluctuations of the United States population in terms of value change. The population is increasingly adopting birth control; therefore our problem was to relate birth control planning (or decision-making) to values.

The Method. We studied the values of the "middle-class" because this class includes the most important

contributors to the fluctuations. We analyzed the content of 300 Ladies Home Journal fiction stories, using five stories from each of the sixty years from 1901-1960. Word descriptions we treated as indicators of the existence of values and their rate of occurrence we assumed indicated the degree of importance and acceptance on the part of readers. The single value categories were logically combined into twenty-three value clusters.

Conclusions. We first tested to see if economic values closely correlated with birthrates. They did not. We found that males no longer accepted economic activities as a "calling." We found that females after 1930 rejected risk and valued home highly but that to have a child was no longer a risk to health. We then noted from another cluster that the male had accepted "love-as-a-force" after 1930, i.e., males turned to the magic of a women's love after rejecting hard work and productivity as values. This change refocused male attention on the female and her desires.

We next found that female equality was accepted by the male after 1930. We had already found the female desired to remain in the home, and we believed her desires during the two-person decision process to gain children would be reflected in the birthrate. Our data supported this belief.

Our data also supported two other hypotheses. One was that great emphasis on the importance of a woman's love would be followed by fear on the part of females that they might not provide that love and would be "alone." The other was that the female's attempt to alleviate that fear of aloneness by having children would be reflected in a rising birthrate. The latter we found until the mid-1950's after which the emphasis was on the "use" of any means which would help to fuse the female into the family group and to relinquish her identity and responsibility as an individual.

Our final hypothesis was that desirability of children would be positively related to both the pre- and post-1930 birthrate. We found that when middle class values regarding children existed at all in the fiction, the middle classes valued them instrumentally, i.e., as a means to one or more ends, rather than as ends (or values) in themselves. The data indicated that there was a strong value conflict regarding children from 1910 to about 1937. After 1937 the conflict disappeared. Values which had earlier made children undesirable to the middle classes had, by the late 1930's, made children desirable. There were virtually no values (or "ends") after 1940 which were incompatible with children. Positive values toward children continued to rise from 1910 to the late 1950's, where they levelled off. This levelling off was not because of any apparent return to older values but rather reflected the fact that children are now only one of several means, all of which were being used to attain fusion of the family and loss of individuality.

Microfilm $2.75; Xerox $7.00. 147 pages.

A STUDY OF ROLE CONSENSUS IN THE FAMILY SYSTEM

(Order No. Mic 61-2090)

Anita Yourglich, Ph.D.
University of Oregon, 1961

Adviser: Theodore B. Johannis, Jr.

The purpose of this study was to determine whether or not persons in the status of husband and status of wife concur with others in the same statuses on the roles associated with these statuses. It was anticipated that they would concur in direct proportion to the extent the structures of their families of orientation and procreation were the same.

The theoretical design upon which the research design was developed was built upon the assumption that one's statuses and roles in one social system are related to one's statuses and roles in another social system by the fact that the same individual participates in both. Thus it is anticipated that one's role in the family system is affected not only by his family statuses but by his statuses in other social systems in which he participates.

The networks of statuses in the family system were conceived of as the structures of that system. As the structures varied, it was anticipated that the expectations or roles associated with the statuses would also vary. Since the relationship between statuses and roles is assumed to be a direct one, it is anticipated that similarity in the structures of the family of orientation into which one is born, and in the structures of the family of procreation which one forms by marriage, is directly related to the role consensus husbands and wives have in their marital statuses.

The hypotheses subjected to test were four general ones, each with several subdivisions. The general hypotheses are the following:

Hypothesis I: Similarity in the structure of the husbands' family of orientation is directly related to husbands' role consensus scores.

Hypothesis II: Similarity in the structure of the husbands' family of procreation is directly related to husbands' role consensus scores.

Hypothesis III: Similarity in the structure of the wives' family of orientation is directly related to wives' role consensus scores.

Hypothesis IV: Similarity in the structure of the wives' family of procreation is directly related to wives' role consensus scores.

Samples of 200 college husbands and their wives were drawn from a western state university and subjected to a battery of Guttman-Edwards scales developed to identify husband and wife roles and measure consensus. The scales had been developed and then checked for reliability and validity on samples of unmarried and married in four pilot studies before the final test. Interviews provided the data on selected family variables.

The degree of role consensus was determined by grouping the husbands' scores as well as the wives' scores and testing for significant difference of means. The areas in

which the groups did not have significant differences were considered the areas of role consensus. The number of areas in which there was consensus was then determined to get the number of concurrences possessed by groups with various selected characteristics. The groups were then compared by number of actual concurrences as opposed to number of concurrences expected by chance. The ratio of actual to expected concurrences was the Index of Consensus. It is this ratio of actual to expected concurrences that determined whether or not a specific hypothesis might be accepted or rejected.

The findings relative to the specific hypotheses under test were, in the majority of instances, positive, and thus indicated that there is some evidence for the general hypotheses that the structures of the husbands' and wives' families of orientation and procreation are directly related to role consensus.

In addition, it may be generally concluded from the research that there is some evidence that a structural theory may be used effectively to conceptualize questions in family sociology; that family sociology can be related to general sociology by means of a structural theory; and that Guttman-Edwards scales can be utilized to tap sociological research areas.

Microfilm $5.60; Xerox $19.80. 437 pages.

SOCIOLOGY, RACE QUESTION

ECOLOGY OF NEGRO COMMUNITIES IN LOS ANGELES COUNTY: 1940-1959.

(Order No. Mic 61-2541)

Dorothy Slade Williams, Ph.D.
University of Southern California, 1961

Chairman: Professor Van Arsdol

One of the major changes in Los Angeles County has been its rapid population growth. An important source of the population influx has been the Negro in-migrant whose rate of increase has surpassed all expected forecasts. Changes in the size, growth, and distribution of the Negro population in Los Angeles County have far-reaching political, social, and economical effects.

The general purposes of this study were (1) to investigate the origin and location of the major Negro communities in Los Angeles County, (2) to examine the social and ecological factors affecting their location and internal structure, (3) to analyze the social, economic, and ecological changes of the Negro population, and (4) to analyze the impact of the increasing Negro population upon the nature and distribution of Negro communities.

Two major hypotheses relating to the proportional distribution of the Negro population were set forth: (1) that areas inhabited by a substantial number or proportion of Negroes tend to increase their Negro proportions, whether rapidly or slowly, whereas a decrease seldom occurs once an area has reached a proportion of 10 per cent Negroes, (2) for communities with the highest proportions of Negroes there is a progressive decrease in proportion of Negroes with increasing distance from the center of the city outward.

The principal source of data for testing the above hypotheses was census material. Using the concept of succession as an analytical tool, 110 census tracts were classified on the basis of the proportion of nonwhite residents to the total population. According to the succession scheme, the tracts were grouped into five stages of invasion, early consolidation, consolidation, late consolidation, and piling-up. Changes in racial composition, educational level, home ownership, age comparison, and overcrowding were analyzed. Negro communities were identified by stages of succession.

Findings. The findings were analyzed under two categories: (1) those relating to the hypotheses of the study, and (2) those relating to stages of succession. The first hypothesis which stated generally that the proportion of Negroes in an area will continue to increase after the 10 per cent level is reached was supported by the empirical findings of the study. The second hypothesis which attempted to verify the existence of a spatial gradient in the proportional distribution of the Negro population from the center of the city outward was not substantiated.

Data analyzed on the stages of succession showed: (1) In each stage of succession the Negro population increased during the 1940-1950 decade. (2) In the consolidation, late consolidation, and piling-up tracts the Negro population decreased from 1950 to 1956. (3) The proportion of Negroes continued to increase in all stages of succession for the entire period under investigation. (4) The Negro population increased more rapidly than the increase in occupied dwelling units in each stage. (5) The increase of nonwhite owner-occupied dwelling units exceeded the increase in such dwelling units for the total population at each stage of succession. (6) The rate of increase in room crowding was greater for the nonwhites than for the total population in the consolidation, late consolidation, and piling-up stages. (7) The median number of school grades completed for the nonwhite population declined slightly in the piling-up and thirty-eight of the consolidation tracts but the total educational attainment of the tracts remained stable. (8) The age composition of nonwhites showed a distinct concentration of persons in ages 15-49 in the consolidation, late consolidation, and piling-up tracts for the ten-year period. (9) The major Negro communities included in this study were in the consolidation category in 1956, except the West Jefferson and Central Avenue communities which were in the late consolidation or piling-up stage.

Conclusion. Certain tentative conclusions relating to Negro communities in Los Angeles County may be drawn from these findings: (1) The original Negro community has served as the core for the establishment of other major Negro communities. (2) New communities are usually formed by centrifugal expansion. (3) Within Los Angeles County, the major Negro communities are concentrated in Los Angeles City. (4) Communities with 10 per cent Negro proportion tend to increase in their Negro proportion. (5) Communities invaded by nonwhites have a more rapid increase in owner-occupancy and room crowding among nonwhites than among the total population. (6) The educational level of communities invaded by nonwhites remains stable or improved. (7) The majority of nonwhites in census tracts with highest concentration of Negroes are in the age group 15-49. (8) The succession concept is a useful tool for the analysis of population trends among nonwhites. On a whole the entire study seemed to point to the continued concentration and segregation of the Negro population in Los Angeles County.

Microfilm $2.75; Xerox $9.00. 200 pages.

DURATION OF ORAL READING TIMES AND SOUND PRESSURE LEVEL UNDER CONDITIONS OF DELAY AND INTENSITY OF SIDE-TONE TRANSMISSION

(Order No. Mic 61-1839)

Frederick Gerard Attanasio, Ph.D.
Ohio University, 1961

Director: Edward M. Penson

Rationale Theorists have postulated that the human speaking system operates as an automatic control mechanism. Interferences in the aural feedback loop create disturbances of vocal output. Perceptions of these vocal deviations promulgate attempts to modify and correct subsequent verbalizations and return speech production to normal. Experimental interference in the form of delayed auditory feedback furnishes a unique method of studying the manner in which the speaker-listener endeavors to attain the goal of normal speech production under controlled conditions.

Purpose The purpose of this study is to investigate three phases of vocal output under conditions of delay and intensity of side-tone transmission.

Procedure Twenty normally hearing subjects participated in the study. For all subjects, the experiment was administered in a sound treated room adjoining a control room containing the apparatus.

The instrumentation was arranged so as to achieve a two-fold purpose. In the first place, the instrumental composition provided for twenty-five combinations of five delays and five intensity levels of side-tone transmission. The time-intervals of delay ranged from .03 second to .40 second, and the intensity-sensation levels extended from twenty decibels to eighty decibels of intensity. The order of presentation for the twenty-five experimental conditions was randomized for each subject prior to the actual testing situation.

Second, the instrumental array allowed for measurements and recordings to be made of the effects of the experimental stimuli on three speech variables: total duration of oral reading time, difference-time and sound pressure level of vocal output. The total duration of oral reading time represented the over-all reading time expended for each experimental condition. Difference-time referred to the algebraic difference between plus-time and minus-time. Plus-time referred to the amount time during which a subject expended more than a previously determined amount of speech energy. The amount of time during which the subject expended less than a previously determined amount of speech energy represented minus-time. The average increments and decrements of vocal output intensity under each experimental condition encompassed the sound pressure level measurements.

During each experimental condition, the speaker-listener read four cards totaling forty equated five-syllable phrases. While the subject read each group of four cards, he experienced a different delay presented at a different intensity level of side-tone transmission.

Results The three dimensional analysis of variance technique was used to analyze the statistical significance of the means obtained for each of the three dependent variables. These results are summarized as follows:

1. The maximum effect on each of the three speech variables occurs for delays presented at eighty decibels of intensity.
2. At sixty decibels of intensity, the total-time, difference-time, and sound pressure level means showing the greatest displacement from their respective vocal output reference levels occurs at the .18 second delay.
3. Time intervals of delay presented with either twenty, thirty, or forty decibels of intensity do not promote significant differences in the mean performance of any of the three dependent variables.
4. Increases in the performance of each speech variable are determined largely by increases in the intensity of side-tone transmission. As the intensity of the side-tone transmission increases, the mean performance of each dependent variable increases proportionately.
5. The results of this investigation tend to support the notion that the human speaking system operates as an automatic control mechanism.

Microfilm $2.75; Xerox $6.80. 142 pages.

EDITORIALIZING IN BROADCASTING

(Order No. Mic 60-2319)

Mary Ann Cusack, Ph.D.
Wayne State University, 1960

Adviser: Paul B. Rickard

This analysis is predicated upon the hypothesis that broadcasters have been granted the right to editorialize, but in the ten years following the Federal Communication Commission's decision in favor of their plea have failed to make adequate use of the privilege. As recently as 1958, John C. Doerfer, chairman of the Federal Communications Commission, warned broadcasters that ten years is a long time to stand in stunned silence -- especially when the press continues to operate in this field virtually unchallenged. He analyzed the present status of editorializing

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

on the air in these terms: "The shock of unexpected victory in 1948, the reversal of the FCC's decision in 1941 to ban editorializing from the air waves, left the broadcasting industry too dazed to exploit the breakthrough."

Doerfer concluded that if broadcasting is regarded solely as an opportunity to make money, the Federal Government will eventually impose stricter regulations or may even make a move for outright re-entry.

These are strong words for the chairman of a Federal agency to use. Not only was the FCC concerned with this problem, but at the same time broadcasters, publishers and private agencies became aware of the crucial issues connected with editorializing on the air.

This analysis is an investigation of the current attitude of the broadcasting industry toward revising editorial policy. Evidence of this attitude is based on national surveys, depth interviews with men closely related to the issues, current literature and programming. Those interviewed included Edward R. Murrow, John Daly and Mike Wallace, representing the field of broadcasting, Royce Howes, Associate Editor of the Detroit Free Press, representing the field of journalism, Charles A. Siepmann of New York University and John Hohenberg of Columbia University, representing the field of education in communication, and Reuel Denney of the University of Chicago, representing the field of sociology.

Background material includes the history of broadcasting, from which the reader may infer that as the industry grew, the problems of what and how much to communicate also grew.

Whether or not the public and network management are thirsty for opinion and controversy on the air, Federal regulations exist which are a controlling factor in present day broadcasting. Included in this analysis is an examination of the extent to which certain Federal legislation and self-imposed regulations foster or hinder the status of the editorial.

The following section is a summary of the reaction toward the subject matter of this study by men in broadcasting, in government, and in educational and professional organizations. The major conclusions drawn from their statements were:

1. Freedom of speech would be menaced if a small group of men took advantage of their position on the air and became "pulpiteers." However, analysts today show little sign of climbing up into the pulpit. Nor would the "fairness" of editorial policy be threatened if they did, unless they all got into the same pulpit.

2. In an attempt to be "above suspicion" in analysis of the news, networks have removed themselves from the area of suspicion. One cannot talk about editorializing or advocate it when so limited amounts of time are given for its expression.

3. It appears that the broadcasting industry is subservient to the sponsor while newspapermen, who "sell" the same amount of space, if not more, appear not at all apprehensive about the whims of individual space buyers.

4. Individual broadcasting stations lack the necessary equipment to editorialize in the way of skilled personnel with "news sense," as well as a direction from management characterized by mature understanding and appreciation of this area of ideas.

5. The criticism of sociologists that there is a lack in the public demand for the editorial may well be due to the fact that in broadcasting today the issues are not given the stage awarded the personality.

6. When the broadcaster himself has the intellectual curiosity and awareness that has been asked of the viewer, the medium will produce programs of a higher caliber. The myths of the low mental age of the general audience appear to be disappearing only to reappear in the "audience" of professionals responsible for broadcasting.

The reader is asked to conclude: When denied freedom of speech, we as a people know what to do; when offered the freedom of speech, do we know what to say?

Microfilm $3.55; Xerox $12.40. 273 pages.

THE MODERN DANCE AS DRAMATIC THEATRE (A COMPARISON OF SELECTED ELEMENTS)

(Order No. Mic 61-1524)

Marion Lorene Davis, Ph.D.
The University of Wisconsin, 1961

Supervisor: Professor Jonathan W. Curvin

This study assumes that modern dance, as an independent art form, incorporates essentially the same formative elements as does the dramatic theatre. The primary difference between the two forms lies in the nature and use of these elements, which vary according to the particular dance or drama under discussion.

Selected elements (subject matter, structure, character, language and production), derived from and defined in the context of traditional dramatic theatre, are analyzed in terms of their function in modern dance. The discussion of each element attempts to define its dimensions with regard to actual practice as determined from a survey of professional modern dance works composed over a period of approximately thirty years, 1927 to 1959. The major emphasis of the study concentrates on dance rather than on drama, and focuses, for the most part, on the performed work of art rather than on the process of creation.

The study follows an organizational logic based on the elements selected. The Introduction gives a brief historical background of modern dance. Chapter I defines terms and explains certain concepts fundamental to the study. Chapters II through VI each contain an analysis of a single element, using examples taken from a wide variety of modern dance works. Chapter VII concludes by discussing these elements in terms of a single dance, Martha Graham's Clytemnestra.

A performed modern dance work, as analyzed in the study, communicates on one or more of three generally defined levels. Level number one, for convenience, may be labeled "basic movement." Here emphasis lies with the movement itself, for the sake of its communicated visual-kinesthetic experience. The second and third levels deal with ideological information derived from the movement. Level number two, called in the study the level of subjective awareness, is illustrated by those dances which attempt to directly project the nature of an emotional feeling. Level number three deals with conceptual or objective data. A dance may communicate upon one, two or all three levels, although a predominant one can usually be identified. It must be emphasized that level number one, being itself the language of dance, occurs in every dance work and is basic to subjective and ideological communication.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

These levels determine the relative importance of a given dramatic element, and the specific form in which that element appears in a dance. Generally the closer a given dance work approaches the third or objective communicative level, the closer will it approximate the use of elements as found in dramatic theatre.

The study, through the utilization of theatre elements, suggests objective lines along which to pursue the analysis of the formal elements of dance. It has attempted to follow a method of critical investigation which gives concrete shape to otherwise elusive aspects of dance and which allows the critic to approach a work by establishing its factual existence as an art object. It also suggests that the element of dance language, as discussed, adds a further dimension common to the analytical study of performing arts in general, that of meaningful identification with the fact of body motion itself. It seems to the writer that these additional factors must add solidity and credence to the sensing of the physical shape and texture of the performance. Microfilm $5.60; Xerox $19.80. 437 pages.

AN ANALYTICAL STUDY OF THE USE OF RHETORICAL DEVICES IN THREE SELECTED PLAYS OF GEORGE BERNARD SHAW: SAINT JOAN, ANDROCLES AND THE LION, AND CANDIDA.

(Order No. Mic 61-2527)

Dorothy Dupler, Ph.D.
University of Southern California, 1961

Chairman: Professor Butler

It was the purpose of this study to discover to what extent and how George Bernard Shaw used rhetorical devices in the dialogue of three of his plays. The plays selected represent different periods of his career. Saint Joan, Shaw's last major drama and his only tragedy, is generally considered his literary masterpiece. Candida, one of his early works, is a realistic domestic comedy. Androcles and the Lion, a "fable play," was written in a period midway between the other two plays.

It was discovered that Shaw's use of metaphor, or imagery, is not great, but that imagery does contribute significantly to the plays. Imagery is subtly used in Saint Joan to present the church as the protecting ruler of society, ever on guard against the Prince of Darkness. The heresy of Joan, pictured as the diseases of leprosy and cancer and then as a pestilence, represents part of Satan's design to damn the world. The imagery is intended to arouse sympathy toward the church and thus strengthen its position in its attack against Joan. The other two plays lack the pervasive and subtle imagery of Saint Joan, but in key situations throughout both of the plays imagery is used to clarify concepts and to arouse emotional attitudes. There seems to be little if any carry-over of imagery from one play to another.

Shaw makes very frequent use of the "figures" of rhetoric. Many rhetorical questions give force to the internal argumentation. Frequent repetitions of identical words give emphasis to key ideas. Parallelisms point up the relationships among concepts. Many multiplications make for wordiness, but they also give clarity and emphasis. Antitheses point up contrasts, thus reinforcing argumentation. Prevalent use of semicolons and colons to divide long sentences into short units makes for added emphasis and tight logic and also simulates spontaneous conversation. Expressive, instantly intelligible diction is also adapted to oral discourse. All of these figures working together contribute to characterization, to the establishing of appropriate moods, and to the creation of Shaw's superb prose rhythm.

The devices are used more frequently and with more artistry in Saint Joan than in either of the other two plays. They are used more prevalently and with more formality in Candida than in Androcles and the Lion. These facts would negate any theory of steady progression in Shaw's skill in the use of language.

The facts indicate, however, that Shaw skillfully adapted his language to the nature of his material. The dialogue of Candida, a pleasant play without extremes of either low comedy or serious discussion of life or death issues, presenting characters of intelligence and fairly high social status, contains a degree of formality and artistry appropriate to its characters. Androcles and the Lion contains extremes of both comic buffoonery and serious discussion. The characters represent a wide range of intelligence and social status. Many of them are inclined to be impetuous and excitable. Accordingly, the dialogue, generally, has less formality and more variations appropriate to erratic and less rational characters. However, in those scenes in which intelligent, highly rational and level-headed characters discuss issues of great seriousness, the rhetorical figures give beauty and eloquence to the dialogue. In Saint Joan, a play which deals exclusively with serious matters, the figures are used prevalently and give to the dialogue a high degree of poetic excellence appropriate to the tragic theme. Microfilm $4.90; Xerox $17.35. 381 pages.

A RHETORICAL ANALYSIS OF THE ORATORY OF WILLIAM PENN

(Order No. Mic 61-2373)

Jon James Hopkins, Ph.D.
The Pennsylvania State University, 1961

The problem in this study was to form a judgment concerning the attributes of William Penn's oratory and his effectiveness as an orator.

In order to attack the problem it was necessary to reconstruct faithfully the components of each speech event in which Penn participated (where a speech text exists); to analyze each of these events in terms of the interaction of speaker, subject, audience, and occasion; to interpret the materials to decide the probable effects of the speeches; and to draw upon the historical, logical, and philosophical constituents.

The study design is reflected in the content and sequence of the chapters.

Chapter I was designed to furnish an insight into the nature, purposes, and methodologies of the dissertation. It includes treatment of such matters as: (1) the origin of the study, (2) a review of the literature, (3) the significance of the project, (4) the problem and its limitation, (5) the

working hypothesis, (6) the plan for a systematic discovery of source materials, (7) the divisions of the study and the respective functions of each, and (8) a philosophical orientation and specific canons for making a rhetorical analysis.

Chapter II examines the subject's personal and rhetorical life in order to come to know the speaker as a man, his audiences, and the occasions on which he attempted to communicate. This chapter is also devoted to an examination of the interrelationships between Penn and Quakerism -- a dominant force in his speaking career.

Chapter III is an analysis of the rhetorical atmosphere in England and the problems of adaptation faced there by Penn.

Chapter IV describes the rhetorical atmosphere in colonial Pennsylvania and furnishes the background for a judgment concerning Penn's speaking in the New World.

Chapter V is devoted to an analysis of Penn's sermons in 1694, and three of his speeches in advocacy of increased freedom of worship for the Quakers and other minority groups.

Chapter VI presents a critical analysis of five of Penn's speeches in statecraft -- speeches delivered in partial fulfillment of his responsibilities as founder and Proprietary of Pennsylvania.

Chapter VII analyzes four of Penn's dialogues and disputations in order to gain insight into his capacities in these modes of rhetorical expression.

Chapter VIII serves the standard function of drawing general conclusions and indicating a direction for additional research.

The following conclusions were drawn:

1. Penn's superior education should have enabled him to speak well.
2. Penn dealt with significant subjects -- freedom of decision and worship, and eternal salvation through adherence to Quakerism.
3. Penn spoke to convince or to actuate.
4. Penn's analyses and consequent adaptations to the relationships of the speaker, subject, audience, and occasion were good in seventeen of the speech events studied -- poor in three.
5. He drew upon excellent sources -- personal experience, the classics, the Bible, and English law.
6. His utilization of the method of advocacy was grossly inadequate.
7. His use of language was surprisingly inconsistent for one so well educated.
8. His delivery -- voice and action -- was satisfactory.
9. Penn appears to have been only an average public speaker.
10. Historical stature justifies such critical studies.

Microfilm $4.20; Xerox $14.85. 327 pages.

A STUDY OF SINGLE AUTOMATIC AND SINGLE MANUAL TRIAL AUDIOMETRY

(Order No. Mic 61-1881)

William Melnick, Ph.D.
University of Pittsburgh, 1961

This study was conducted to get an indication of the characteristics of monaural sensitivity measures for pure tones found by using single stimulus trial testing techniques. The single trial tests were performed on automatic, subject controlled equipment, and manual, tester controlled apparatus. The method of limits and method of adjustment were used with the single trial techniques. Threshold was approached in an ascending and in a descending direction. The single trial measures were compared to threshold scores from a multiple trial, clinical pure tone, air conduction test. The reliability of the various techniques was studied using the test-retest method. The moment to moment, day to day variation of the single automatic ascent and descent trials was explored.

Data came from three separate substudies. The subjects were normal hearing, seventh- and eighth-grade school children. The first substudy used 36 subjects. Each of the subjects was tested using the standard clinical test, a single automatic ascent trial test, a single automatic descent trial test, and a retest on one of these techniques. The left ear of each subject was tested using the frequencies 500, 1000, 2000, 4000, and 6000 cycles per second. For the single automatic ascent and descent techniques, two trials were performed at each frequency to determine the effect which the experience of having made one trial threshold crossing would have on the second trial score.

The second substudy used 24 subjects. These subjects were tested by the standard clinical, single manual ascent, and single manual descent technique. A retest using one of the tests was made. Test ear and test frequencies were the same as in the first substudy.

The third substudy tested 20 subjects with the single automatic ascent and descent techniques. Ten trials were made with each technique on the left ear at 1000 cycles. This procedure was employed on two consecutive days.

Within the limitations of the study the following conclusions were made:

1. Test technique has a significant effect on hearing sensitivity measures.
2. Hearing sensitivity measures from single automatic and manual trials, ascent and descent, are positively correlated to threshold measures from a standard clinical test.
3. Direction of the single automatic trials affects the hearing sensitivity measures.
4. The experience of one threshold crossing by the single automatic trials, ascent and descent, appears to have an effect on the scores of a second threshold crossing.
5. The standard clinical test shows more stability in the test-retest than single automatic trials. No statistically significant difference is seen between any of the test-retests, regardless of technique.

6. No significant difference was found in the moment to moment, day to day variation of the single automatic ascent and descent trial measures for a 1000 cycle tone.
7. Time per sensitivity measurement for the automatic single trials was less than half that taken by the standard clinical threshold technique. The single manual trials did not greatly reduce the time required per test measure.

Although there appeared to be a statistically significant difference between single trial and multiple trial test scores, the practical significance of these differences was questioned. It was felt that the single trial techniques might be used to give a rapid hearing sensitivity index.

Microfilm $2.75; Xerox $9.45. 207 pages.

A HISTORICAL STUDY OF SPEECH EDUCATION AT THE UNIVERSITY OF SOUTHERN CALIFORNIA (1880 THROUGH 1950)

(Order No. Mic 61-2537)

Earl Washington Priddy, Ph.D.
University of Southern California, 1961

Chairman: Professor McCoard

The purpose of the study was to make a historical investigation of the development of speech education at the University of Southern California from 1880 through 1950. Some specific questions of the problem were: (1) What prompted the establishment of speech training at the time the University was founded? (2) What guiding philosophies and goals developed through the years? (3) What changes in administration were found in speech education at the University from 1880 through 1950? (4) In what respects did extracurricular activities give opportunity for speech participation? (5) What developments were found in graduate speech work at USC up to 1950? (6) What contributions to speech education were made by USC from 1880 through 1950? (7) What trends in speech education found at USC were part of the national picture?

Personal data were obtained from questionnaires and tape-recorded interviews with active and retired instructors of the School of Speech, former graduates, and administrators. Other data were compiled from the original minutes of the Board of Trustees of the University; from University bulletins, periodicals, catalogues, yearbooks, newspapers; and from books, letters, scrapbooks, and related graduate studies.

When the University opened in 1880, a course in Elocution was offered by Miss M. D. McChain. Seven students comprised the class. In 1895, when the College of Oratory with Maude Willis as Dean was organized, courses offered were Oratory, Elocution, Physical Culture, Bible, and Hymnology. The goals for the two-year curriculum were (1) to develop readers, (2) to train speakers, and (3) to train teachers. Important extracurricular speech activities (often sponsored by one or more of five literary societies) were elocution recitals, debates, and oratorical contests. In 1898 Lee Emerson Bassett, Principal of the College of Oratory, strove to change the emphasis from mechanics and display to thought-motivated performances. Jesse Martin Roberts (1899-1903) developed a four-year program and a postgraduate class. Beulah Wright and Elizabeth Yoder, Deans (1903-1917 and 1917-1924, respectively), were largely responsible for developing the College (renamed School of Speech by Yoder, 1920), which comprehended a wider range of instruction in public speaking, dramatics, and debate than any other university on the Pacific Coast. Under Dean Ray K. Immel (1924-1945) noteworthy accomplishments were (1) development of the graduate program; (2) participation in international forensics; (3) development of the speech correction area and organization of the Speech Clinic, 1930; and (4) encouragement of experimental drama under Florence Hubbard, Cloyde Duval Dalzell, and William C. deMille. Chief developments, 1945 through 1950 were: (1) the School became a Department of Speech, 1945; (2) drama and radio formed separate departments in 1945 and 1946, respectively; (3) The Institute of the Arts was organized and included the departments of Cinema, Drama, Fine Arts, Music, Radio, Speech; and (4) the Speech and Hearing Clinic was established in 1947 under Lee Edward Travis.

The pattern of development of speech education at USC generally paralleled that of other leading institutions in the East. Gradually, the general emphasis changed from training platform specialists to offerings for students in liberal arts as well as those specializing in drama and speech correction. The interest in graduate research which began under Dean Immel continued until, in 1950, USC was among the nation's top six universities in the conferring of graduate degrees in speech.

Microfilm $6.60; Xerox $23.40. 517 pages.

THE HISTORY OF THE THEATRE IN PORTLAND, OREGON, 1846-1959.

(Order No. Mic 61-1553)

Lester Lorenzo Schilling, Jr., Ph.D.
The University of Wisconsin, 1961

Supervisor: Jonathan W. Curvin

Portland, Oregon, established near the intersection of the Columbia and the Willamette Rivers, became an early center of the Pacific Northwest. This study brings together information concerning its theatrical development from early days up to the year of 1959. Newspaper files furnish an unbroken chronology of information augmented by other types of sources. The more recent history was enriched through personal interviews with many of the participants in its events.

In 1846 some very unusual theatrical entertainment was offered aboard the British gunboat, Modiste, which lay at anchor in the Columbia River for over a year. The first known professional entertainer to come to Portland was Stephen C. Massett, who put on a one-man show. Portland started attracting a number of acting troupes from San Francisco in the eighteen fifties. Meeting halls served as make-shift theatres during this time. The first building erected specifically for theatrical use opened in 1858 as Stewart's Theatre but was known as the Willamette Theatre throughout most of its ten years of active history. The

theatrical dominance of the Willamette Theatre was followed by the Oro Fino Theatre which was a second story theatre eclipsing the Willamette in 1868 by furnishing patrons and performers with increased comfort. Both the Willamette and the Oro Fino housed companies which remained in residence for considerable periods of time.

In 1875 the New Market Theatre became the first brick theatre building in Portland and supplanted the Oro Fino as the city's theatrical center. Meanwhile, the city was growing rapidly and small theatres began to appear which specialized in various peripheral entertainments. The saloon-theatres, variety halls, and foreign language theatres flourished at this time. The saloon-theatres gave way to the reform movement of 1865 and the variety halls were supplanted by the development of vaudeville. Of the foreign language theatres, the Chinese was most active but like the others died with the Americanization of its patrons.

The touring of legitimate companies reached its height during the first decade of the twentieth century. In the following years it was affected by the general nationwide decline of road companies, the location of the Pacific Northwest, and the shortage of theatres in Portland.

Resident stock companies were active from 1896 until 1933. These companies gained community loyalty and support, with John Cordray's, the Baker, the Lyric, the Alcazar, and the Duffy being the most prominent of the many organizations.

Amateur theatrical activities started early in the city's life with dramatic societies putting on full length plays by the eighteen seventies. It was not, however, until after the First World War that amateur dramatics enjoyed an unbroken chronology of activity, with the nineteen twenties characterized by voluminous activity and many different organizations. Out of this period the Portland Civic Theatre emerged as the dominant amateur organization.

The Oregon Federal Theatre Project was centered in Portland and originally did vaudeville shows because most of the unit's personnel were vaudeville entertainers. Under the direction of Bess Whitcomb the unit went on to produce legitimate shows including a number that were highly original.

Portland's history has shown much of its population to be conservative and unreceptive to the subject matter and dialogue of many of the plays. The city has allowed the theatre a great deal of freedom, however, and many of the managers in turn have shown respect for their patrons' tastes by cutting the most objectionable features from their productions.

The relationship between the community and the theatre professionals has been an unusually friendly one with only isolated examples to mar this generally happy relationship. Portland theatre patrons have proved loyal to the best plays and ablest performers.

Microfilm $6.45; Xerox $22.95. 508 pages.

SOME FACTORS IN THE EFFICACY OF TRAINING MOTHERS OF SLOW LEARNING AND NORMAL CHILDREN WITH FUNCTIONAL ARTICULATION PROBLEMS

(Order No. Mic 61-1888)

Ronald Kenneth Sommers, Ed.D.
University of Pittsburgh, 1961

This study determined the effects of training mothers of children with functional misarticulation when two other factors were varied. One of these was the intelligence of the subjects and the other was the scheduling of children for individual or group speech therapy.

From a group of 155 school-aged children with speech problems 80 children who met the requirements of having normal hearing, functional misarticulations, and intelligence quotients within certain ranges were selected as subjects. These subjects were enrolled in a four-week intensified speech therapy program conducted after the termination of the regular school year by school speech clinicians.

Forty of these subjects had intelligence quotients within the range of 70-90. These children were randomly assigned to one of four experimental groups. One group of ten subjects received individual speech therapy for a 30 minute period each day during a four-week program and in addition, their mothers were trained to assist in the correction. A second group of ten slow learning subjects received group therapy for 50 minutes daily during this four-week period and their mothers were trained. A third group received individual therapy and their mothers were not trained. A fourth group received group speech therapy for 50 minutes daily, and their mothers were not trained. Forty subjects whose intelligence quotients were within the range of 90-115, were randomly assigned to four experimental groups identical to those described for the slow learning subjects. There were eight experimental groups of ten subjects in all.

Two criterion measurements were used to test the main effects of training versus non-training of mothers, slow learning versus children of normal intelligence, and individual versus group therapy. The major measurement was articulation difference scores; the secondary one was auditory discrimination difference scores.

Measurements of reliability of articulation testing for the six raters indicated that the inter-group agreement of 83 per cent and the test-retest agreement of .91 agreed well with that reported by other researchers. Auditory discrimination reliability was found to be sufficiently high for research purposes also.

An analysis of variance statistical procedure was used to test for differences between the means of the eight experimental groups and test all of the possible interaction effects. The results of this analysis indicated the following:

1. Groups of subjects whose mothers were trained to assist in the correction of their misarticulations made significantly greater progress in improving articulation than subjects whose mothers were not trained.
2. Children with normal intelligence achieved greater improvement in articulation than did the slow learning children.
3. Group and individual therapy were equally effective in improving articulation for all the children studied.
4. Training mothers of children with normal intelligence resulted in their children achieving significantly

greater improvement than training mothers of slow learning children.

5. The amount of improvement in articulation resulting from training mothers was not affected by scheduling subjects in individual or group therapy.

6. The significant amount of improvement in articulation made by children of normal intelligence compared with slow learning children did not depend upon whether individual or group therapy was provided.

7. A combination of training mothers, children with normal intelligence, and individual therapy appeared to provide the greatest improvement in articulation.

8. No significant differences in mean auditory discrimination scores were found between the eight groups of subjects.

9. A significant relationship was found between the changes in auditory discrimination abilities of trained mothers and the amount of improvement that their children made in articulation.

10. Mothers trained improved significantly in auditory discrimination abilities compared with mothers not trained.

Microfilm $2.75; Xerox $5.00. 100 pages.

THE CONGRESSIONAL SPEAKING OF THADDEUS STEVENS

(Order No. Mic 61-2514)

Raymond Warren Tyson, Ph.D.
Purdue University, 1961

Major Professor: N. B. Beck

This study investigated and evaluated the Congressional speaking of Thaddeus Stevens, Representative from Lancaster, Pennsylvania, who was a member of the Thirty-first and Thirty-second Congresses, 1849-53, and returned to serve in the Thirty-sixth to the Fortieth Congresses, 1859-1868.

To appreciate fully the Congressional speaking of Stevens it was necessary to examine his educational background, his public career before he entered Congress, and his many years as a member of the Pennsylvania bar.

In his first two terms in the House Stevens spoke against slavery with a bitter and impassioned eloquence that marked him as an inveterate enemy of human bondage. In his denunciations of the Compromise of 1850 he exhibited to the House a high talent for savage satire and caustic wit.

When Stevens returned to Congress in 1859, secession was imminent. He at once declared his position on the issues of the day. He opposed making any concessions to the South, and was unsparing in condemnation of secessionists. His attacks on slavery continued with unabated vehemence.

As chairman of the Ways and Means committee in the Thirty-seventh Congress, he gave unstinted oral support to the administration of President Lincoln on financing the war. On many other questions he severely criticized the administration. Stevens was impatient with temporizing measures, and demanded a relentless prosecution of the war.

When the Thirty-eighth Congress convened, Stevens was virtually dictator of the House of Representatives, and relinquished his position of authority only with his death in 1868. During and after the war he was associated with practically every piece of important legislation originating in the House. He was intimately involved in the passage of the Thirteenth and Fourteenth Amendments, and he set the framework of the ultimate passage of the Fifteenth Amendment. He was a major voice in the impeachment proceedings against Andrew Johnson.

Testimony from contemporaries, both in and out of Congress, indicated that Stevens was an extremely effective speaker. His colleagues in the House ranked his as a debater second to none. Few speakers in public life have used satire, sarcastic wit, and invective with the force of Stevens. He was an aggressive speaker, and his primary method was one of attack.

Evidence indicated that Stevens carefully prepared his major addresses, but was often required to speak with little opportunity for preparation, and many times impromptu. Essentially a forensic speaker, he employed a legalistic mode of argument in many speeches before the House. Stevens used emotional appeals as often as logical patterns. Not copious in his use of illustrations, his allusions were apt and frequently picturesque.

Many historians have labeled Thaddeus Stevens vindictive because of the punitive legislation he proposed for the South during the Reconstruction era. Many have ignored his frequent and eloquent expressions of idealistic concepts of the right of all men to human dignity and equality of opportunity. No man in the public life of his time did more for the American Negro than Stevens. He spoke for suppressed minorities with a bitter but at times a compelling oratory.

The thesis includes a detailed study of six major addresses of Thaddeus Stevens, the speech situations in which they were delivered, and the critical reaction to them, as well as briefer discussion of his other important Congressional speeches.

Microfilm $4.50; Xerox $15.75. 349 pages.

THE COMPOSITION OF FISH COMMUNITIES IN RELATION TO RIVER POLLUTION

(Order No. Mic 61-1856)

Daniel George Bardarik, Ph.D.
University of Pittsburgh, 1961

An attempt was made to evaluate the interrelationships between the physical, chemical, and biological factors that affect the distribution of fish in a polluted stream, the Clarion River, and make a comparison with the distribution of fish in a relatively unpolluted neighboring stream, the Tionesta Creek.

Both streams are located in Northwestern Pennsylvania in the Allegheny River Drainage Basin noted for its rich fish fauna containing 25 families and more than 125 species of fish. Both streams have a similar physiography, stratigraphy, gradient, and have been unaffected by glacial activity.

The Clarion River is polluted by tannery wastes, acid mine wastes, pulp and paper mill wastes, and untreated domestic sewage.

Collections were made at 18 stations over 79 miles on the Clarion River and at 14 stations covering 49 miles on the Tionesta Creek during a five year period. Collections were obtained by seining and shocking.

Thirty-four species of fish belonging to 7 families were collected from the Clarion and 45 species belonging to 8 families were collected from the Tionesta. Of those that occurred in the Clarion, all but two occurred in the Tionesta.

The physical and chemical factors rarely exceeded the known limits of tolerance for the various species except during periods of very low flow or of excess discharge of waste materials. These periods were never prolonged enough to cause a large scale fish kill during the period studied. Factors examined included water temperature, dissolved oxygen, pH, light transmission, turbidity, river flow, alkalinity, 5 day B.O.D., and stream gradient.

A distinct difference exists in the longitudinal distribution of fish in the two streams. The greatest difference was noted below the waste effluents. Minor variations occurred which may be attributed to factors such as gradient, rate of flow, size of stream, and collecting efficiency.

The rapid rate of recovery and the maintenance of river conditions within lethal limits for the fishes represented is a result of low flow augmentation by regulated release of water from a U.S. Army Engineers dam in the headwaters and the regulated release of wastes from the pulp and paper mill.

The fish populations survive and maintain themselves during periods of excessive discharge of wastes by aggregating at the mouths of tributaries until conditions become suitable for their return to the main stream.

The distributional pattern displayed by the fishes tends to remain uniform from year to year with very little apparent deviation.

Certain species were found to range throughout the length of both streams while other species were found to be confined either to the headwaters or restricted in their upstream distribution to a region below the area of initial pollution.

A seasonal fluctuation was noted in the distribution of fish in the headwaters of the Clarion. Fish populations were found to remain relatively stable in the larger downstream areas during all seasons, while a reduction in number of species was apparent in smaller upstream areas during the winter months.

It appears that food is not a limiting factor to the distribution of fish in the Clarion River.

A reduction in the number of species of fish and an increase in the total number of individuals of tolerant species occurred in the region of pollution. As the waste materials became dispersed downstream, the number of species increased with a corresponding decrease in the number of individuals of each species. Influx of pollution caused a reduction in diversification and reduced the stability of the fish community. As the pollution dispersed downstream, the fish community became more diversified and approached stability. The species - diversity index was employed to graphically illustrate this relationship.

Microfilm $2.75; Xerox $6.60. 140 pages.

A STUDY OF THE GLYCOLYTIC ENZYMES IN THE AQUATIC SNAIL PHYSA HALEI LEA

(Order No. Mic 61-2199)

Calvin Greenwood Beames, Jr., Ph.D.
The University of Oklahoma, 1961

Major Professor: Harriet Harvey

Recent studies of intermediary carbohydrate catabolism of invertebrates have pointed to a general concept of biochemical unity. At the same time however these studies have shown that manifold deviations from classic metabolic processes do exist.

The glycolytic sequence and initial steps of the hexose monophosphate shunt were investigated in homogenates and extracts of the aquatic snail Physa halei Lea.

Both glucose-6-phosphate and 6-phosphogluconate dehydrogenase were demonstrated and they resemble the mammalian enzyme in co-factor specificity. The presence of these two enzymes, and the fact that they exhibit relatively high activity rates, suggests a functional hexose monophosphate shunt in P. halei.

Efforts to follow anaerobic acid formation by manometric methods did not produce satisfactory results. The measurements obtained suggest an active carbonic anhydrase is present which interferes with the measurement of total acid production.

Evidence for the presence of the glycolytic enzymes,

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5-1/2 x 8-1/2 inches, 4-1/2 cents per page.

phosphoglucomutase, phosphoglucoisomerase, aldolase, triosephosphate isomerase, alpha-glycerophosphate dehydrogenase, glyceraldehyde-3-phosphate dehydrogenase, phosphoglyceric kinase, phosphoglyceric mutase, enolase, phosphopyruvate kinase, and lactic dehydrogenase is presented. Most of these enzymes have characteristics similar to mammalian enzymes; a few do not.

Aldolase of P. halei has characteristics which suggest a metallo-protein and more closely resembles the enzyme found in microorganisms than in mammalian tissue.

Lactic dehydrogenase in P. halei, which has low activity, functions as well with TPN as with DPN. In this respect the enzyme is quite different from the mammalian tissue enzyme.

Fluoride did not inhibit pyruvate production in minced tissue of the snail. However, the ion definitely inhibits enolase.

The presence of a malic enzyme was investigated, and while malic acid was found to stimulate the formation of TPNH and pyruvate, the pyruvate formation was not accompanied by an equal molar formation of reduced TPN. Pyruvate formation was observed in the absence of TPN. A malate to pyruvate step could explain the accumulation of pyruvate observed in minced tissue with fluoride added to the system. Microfilm $2.75; Xerox $4.80. 91 pages.

THE INFLUENCE OF HYPOTHYROIDISM AND CHORIONIC GONADOTROPHIN ON OVARIAN AND ADRENAL ASCORBIC ACID IN THE RAT

(Order No. Mic 61-2175)

Richard Perry Blye, Ph.D.
Rutgers University, 1961

Major Professor: Dr. James H. Leathem

Hypothyroidism potentiates a follicle stimulating-like action of chorionic gonadotrophin in the rat resulting in the formation of large cystic follicles which contribute substantially to the enhanced ovarian weight increase. Ascorbic acid was used as an endpoint to assess biochemical changes associated with cystic ovary formation.

Immature female rats thirty days of age were fed a purified diet containing 20% casein for 30 days. Hypothyroidism was induced by incorporating 0.5% thiouracil in the diet and both hypothyroid and euthyroid groups received daily subcutaneous injections of 10 I.U. chorionic gonadotrophin on the last 20 days of the experimental period. Hypothyroidism retarded the ovarian weight gain seen in normal control animals but enhanced the action of chorionic gonadotrophin which caused a tenfold increase in ovarian weight. Chorionic gonadotrophin caused an ovarian weight increase of more than twofold in euthyroid animals.

Hypothyroidism alone had no effect and chorionic gonadotrophin alone caused a small but significant decrease in ovarian ascorbic acid concentration. The vitamin C content of cystic ovaries was significantly lower than in all other groups and was roughly inversely proportional to ovarian size.

While follicular cyst fluid was practically devoid of ascorbic acid and became a substantial diluting factor when the entire ovary was considered, the remaing ovarian residue still showed a reduction in vitamin C content to about one-half that found in normal ovaries.

Dessicated thyroid (0.1%) in the diet of animals on the cyst induction regime, completely prevented the formation of cystic ovaries and the associated decrease in ascorbic acid content. Two micrograms of sodium 1-thyroxine administered subcutaneously daily throughout the experimental period prevented the formation of cystic ovaries in the majority of rats used while 1.0 μg. daily failed to prevent cystic ovary formation in any animal.

Neither Chlorprophenpyridamine maleate (Chlor-Trimeton Maleate, Schering) nor relaxin (Releasin, Warner-Chilcott) administered in daily subcutaneous injections on the last 20 days of the experimental period had a significant effect on cystic ovary formation.

The injection of small quantities of turpentine beneath the ovarian bursa failed to induce cystic ovary formation in rats maintained on a normal diet or on a diet containing thiouracil for as long as four months.

Spontaneous regression of experimentally induced ovarian cysts occurred most frequently when a singly ovary weighed less than 200 mg. Rats were subjected to laparotomy after cyst induction, the smaller ovary was removed for ascorbic acid analysis and the animals were permitted to recover without further treatment for 20 days on a normal diet. Removal of the second ovary after recovery allowed a comparison of both ovaries from a single animal for evidence of spontaneous cyst regression. Ascorbic acid changes generally paralleled the degree of follicular cyst formation although some large cystic ovaries which showed regression of a weight basis had a lower ascorbic acid content than might be indicated from their morphology.

While there was no significant difference in adrenal ascorbic acid content in euthyroid, gonadotrophin-treated euthyroid or in non-treated hypothyroid rats, animals treated for cyst induction showed a significant decrease in adrenal vitamin C concentration. This drop in ascorbic acid was not seen in similarly treated animals which were ovariectomized on day 11, prior to treatment with chorionic gonadotrophin. Adrenal atrophy seen in hypothyroid rats was even more pronounced in animals treated for ovarian cyst induction but this was negated by ovariectomy prior to chorionic gonadotrophin administration.

Twelve hours after the intravenous injection of Evans blue (T-1824), cystic follicles containing less than 20 mg. of fluid showed the greatest concentration of the dye while cysts of larger size exhibited considerably less dye uptake. Dilution alone could not adequately explain these results. Normal follicles, whose size did not permit quantitation, were deeply tinged with dye.

Microfilm $2.75; Xerox $4.40. 85 pages.

THE NEARCTIC GENERA OF THE TRIBE ANTHOMYIINI (MUSCIDAE, DIPTERA) WITH A LIST OF THE NEARCTIC SPECIES.

(Order No. Mic 61-1943)

William Arthur Drew, Ph.D.
Michigan State University, 1958

Major Professor: Roland L. Fischer

A generic arrangement of the Nearctic Anthomyiini is presented. Discussions of the genera are presented, as well as keys to the Nearctic subfamilies of Muscidae, to the Nearctic tribes of Anthomyiinae, and to the Nearctic genera of Anthomyiini.

In the literature review and in the generic discussions the arrangements of earlier workers are presented along with a brief generic description. The Nearctic species and their synonomy belonging to each of the genera are listed.

The tribe is arranged into twenty-two genera: Alliopsis Schnabl and Dziedzicki (2 species), Anthomyia Meigen (1 species), Anthomyiella Malloch (1 species), Calythea Schnabl and Dziedzicki (2 species), Circia Malloch (1 species), Egle Robineau-Desvoidy (14 species), Emmesomyia Malloch (3 species), Eremomyia Stein (8 species), Eremomyioides Malloch (6 species), Eustalomyia Kowarz (3 species), Hydrophoria Robineau-Desvoidy (27 species), Hylemya Robineau-Desvoidy (163 species), Kingiella Curran (1 species), Leucophora Robineau-Desvoidy (10 species), Macateeia Malloch (2 species), Macrophorbia Malloch (1 species), Neohylemyia Malloch (3 species), Opsolasia Coquillett (3 species), Paraprosalpia Villeneuve (16 species), Pegomya Robineau-Desvoidy (97 species), Proboscimyia Bigot (2 species), Pycnoglossa Coquillett (9 species). In total, there are 375 described Nearctic species of Anthomyiini.

Microfilm $2.75; Xerox $7.60. 162 pages.

THE POPULATIONS, HABITAT RELATIONS AND ECOLOGICAL CHANGES IN THE WINTER BIRDS OF THE RALEIGH, NORTH CAROLINA, REGION, 1880-1959.

(Order No. Mic 61-2288)

John Broadus Funderburg, Jr., Ph.D.
North Carolina State College, 1960

Supervisor: Thomas L. Quay

A comparative analysis was made of the relative abundance, residence status, and habitat relations of the winter birds of the Raleigh, North Carolina, region during the seventy-nine year period, 1880-1959.

There were two bases for this analysis. The literature was the source of data for determining residence status and relative abundance from 1880-1956. Field research conducted from 1956 to 1959 gave a current intensive analysis of relative abundance and residence status and made it possible to determine detailed habitat relations for the first time.

The annotated list describes 145 species and well-marked subspecies recorded in winter at Raleigh, subdivided by residence status as follows: Irregular Winter Visitants, 42 species; Regular Winter Visitants, 25 species; Winter Residents, 27 species; and Permanent Residents, 51 species.

The changes in status of all species recorded are presented in tabular form. These tables give changes in relative abundance and residence status or both and the approximate date that the trend toward a change in status became definite.

Eighty-nine species showed no change in relative abundance or residence status.

Fifty-five species (38 per cent of the total list) showed changes in relative abundance or residence status or both as follows: Irregular Winter Visitants, 8 species; Regular Winter Visitants, 17 species; Winter Residents, 14 species; and Permanent Residents, 16 species. Of these totals, 31 species increased in relative abundance and changed residence status; 3 species increased in relative abundance without changing residence status; 11 species decreased in relative abundance and changed residence status; 7 species decreased in relative abundance without changing residence status; and 3 species maintained the same relative abundance but changed residence status.

Twenty-two particular factors associated with these changes were determined during this study. The data from four types of censuses conducted during the three winters, 1956-1959, were analyzed to determine the relative abundance and frequency of occurrence of each species recorded in each of the habitat types in the region. This information was the basis for the author's determination of these factors.

Habitat modifications have been the major factor associated with the majority of the changes in status of the winter birds. Of the fifty-five species which changed status, thirty-seven species (67 per cent) changed as a result of changes in habitat. Thirty of these species (81 per cent) increased while seven species (19 per cent) decreased.

Population changes outside the region resulted in the first appearance or increased relative abundance of seven species (13 per cent). All increased during the period 1880-1959.

Collecting, or cessation of collecting, was a factor in the changed status of another seven species (13 per cent). One species increased as a result of complete legal protection while the other six decreased as a result of overcollecting.

Climate has exerted a broad over-all influence on the region, and while critically operative at times on certain species, in general operated in conjunction with some other factor or factors. Only four species (7 per cent) were seemingly affected by climate alone. Three of these species no longer occur at Raleigh, while the fourth is no longer common.

Changes in local weather conditions are a very important factor in controlling movements, distribution, and abundance of winter birds. Severe weather causes most birds to leave the more open habitats and concentrate in sheltered spots where food is available. Such concentration intensifies both inter- and intraspecific competition for food and makes the birds more subject to predation, so that prolonged unfavorable conditions may result in a reduction in numbers in a variety of habitats.

Microfilm $2.75; Xerox $6.00. 121 pages.

CONDITIONS FOR THE CULTURE OF ARTHROPOD TISSUES

(Order No. Mic 61-2479)

Judith Ann Parsons Haskell, Ph.D.
Purdue University, 1961

Major Professor: Richard C. Sanborn

The growth of ovary, hepatopancreas, nerve, muscle, and blood of the marine arthropod, Limulus Polyphemus, was studied in a medium designed for the animal. This growth was compared to that observed when tissues were cultured in medium containing serum or in serum alone.

Two indications of growth occurred in explants of Limulus: (1) cells migrated from explants of all of the above mentioned tissues, and (2) long filaments of protoplasm spread radially from explants of ovary and hepatopancreas. Polygonal-shaped cells migrated from explants of leg nerve in medium containing serum. In the same medium all other tissues produced spindle-shaped or rounded cells. Free cells were agranular in cultures of ovary and hepatopancreas, granular in cultures of blood, and changed from agranular to granular in cultures of cardiac muscle. Granular cells had longer life spans than did agranular cells.

No cellular migration, mitosis, or tissue contraction was observed in ovarian explants of diapausing Cecropia not competent to initiate adult development. Cells migrating from ovarian explants were maintained longer in medium containing adrenal cortical extract and P. quinquemaculata blood than in any other combination of ingredients.

A technique involving the counting of free cells was used to determine the effect of B-vitamins on growth of ovaries of Cynthia pupae. The addition of choline, biotin, and m-inositol each at a concentration of .01 μg./ml. to the medium increased the number of free cells 70 fold. The addition of other B-vitamins is unnecessary, and the same concentration of calcium pantothenate inhibits cell migration.

Experiments involving larvae and pupae from several species of Lepidoptera indicate that growth of their tissues in vitro is regulated by an interplay between intrinsic factors of the explants, and extrinsic factors added with the culture medium or resulting from the nutrition of donor animals. Microfilm $2.75; Xerox $7.00. 146 pages.

SUBSTANCES FROM FUNGAL FERMENTS INHIBITORY TO MEXICAN BEAN BEETLE (EPILACHNA VARIVESTIS MULS.) FEEDING.

(Order No. Mic 61-2487)

Albert Nobuhiro Kishaba, Ph.D.
Purdue University, 1961

Major Professor: D. L. Shankland

This study was concerned with the isolation of two insecticidal compounds, 379-X and 379-Y, from the cultural filtrate of the soil fungus grown on Staley's corn steep-dextrose medium, designated as 55-379 (Tentatively identified[1] as Myrothecium roridum Tode) and the preliminary toxicological investigations with the pure compounds.

Two compounds 379-X and 379-Y were isolated through the following steps: (1) cultural filtrate free of mycelial growth was adsorbed on charcoal; (2) the charcoal was successively washed with methanol and acetone; (3) the active components were eluted from the charcoal with benzene-acetone (50:50, V/V) solution; (4) the eluant was then concentrated and was then extracted successively from basic and acidic water with diethyl ether as the organic solvent; (5) the neutral fraction was subjected to eight-plate countercurrent distribution (hexane, 50%; methanol, 5%; water, 45%; V/V), or simple partition (hexane, 50%; methanol, 25%; water, 25%; V/V), or hexane precipitation, according to the specific activity of the neutral fraction; (6) final fractionation was made through an alumina column with the eluents benzene, 10% chloroform in benzene, 20% chloroform in benzene, 50% chloroform in benzene, 50% ethyl acetate in benzene, and 10% ethanol in ethyl acetate; (7) 379-Y was crystallized from the 20% chloroform in benzene eluant with benzene-hexane system (1:3, V/V); (8) 379-X was crystallized from 10% ethanol in ethyl acetate eluent with ethanol-hexane system (1:3, V/V).

A few physical and chemical characterizations were made for each of the compounds. The characteristics of 379-X are: the tentative molecular formula, $C_{25\sim29}H_{35\sim40}O_{8\sim9}$; the tentative molecular weight 492 (Rast Camphor Method); ultraviolet absorption maxima are from 259 to 263 millimicron with an epsilon of 20, 455 (methanol); the melting point is 190°C.±2; soluble in most organic solvents; slightly soluble in hexane and sparingly soluble in water (ca. 10^{-5}M.); optical rotation $[\alpha]_D^{25}$ = +178.0 (103.78 mg. in 2 ml of dioxane); gave negative tests with ammoniacal silver nitrate, Ehrlich diazo test, 2,4 dinitrophenylhydrazine, bromothymol blue, and bromo cresol green; gave positive test with alkaline permangante; the infrared spectrogram (ca. 1.5% KBr pellet) showed strong absorption (in microns) at 8.65 and 9.22; medium absorption at 2.83, 3.42, 5.65, 5.80, 6.09, 6.24, 7.04, 8.10, 9.62, 10.40, 10.90, 12.25; and weak absorptions at 11.48, 11.95, 13.20, 13.80, 15.47.

The characteristics of 379-Y are: the tentative molecular weight, 903 (Rast Camphor Method); the tentative molecular formula, $C_{49}H_{63\sim64}O_{16}$; the ultraviolet absorption maximum is at 259 millimicrons with epsilon of 41,104 (in methanol); no distinct melting point was present but it decomposed at ca. 295°C; optical rotation $[\alpha]_D^{25}$ = +200.5 (90.84 mg. in 1.3 ml of dioxane), +226.5 (10 mg. in 3 ml. of dioxane); soluble in most organic solvents; slightly soluble in hexane and sparingly soluble in water (ca. 10^{-6}M.); gave negative tests with ammoniacal silver nitrate, Ehrlich diazo test, 2,4 dinitrophenylhydrazine, bromothymol blue, bromo cresol green; positive test with alkaline permanganate; acid hydrolyzate gave negative test with Tollens' reagent; the infrared spectrogram (1.5% KBr pellet) showed strong absorptions at (in microns) 5.88, 7.92, 8.44; medium peak at 3.42, 7.06, 7.26, 9.22, 9.76, 10.01, 10.38; and weak peaks at 6.16, 6.32, 11.30, 12.15, 13.26, 14.55, 15.55.

The topical application of the compounds to the mouth parts indicated that 2.5 microgram of 379-X and 0.25 microgram of 379-Y per insect caused 69 and 75% inhibition of Mexican bean beetle feeding. Preliminary

electro-physiological experiments with the isolated ventral nerve cord of the American cockroach, Periplaneta americana (L.), indicated no pronounced effect on the spontaneous activity or on transynaptic conduction in the 6th abdominal ganglion. The insitu experiment with the Mexican bean beetle indicated some decrease in spontaneous activity 12 to 48 hours after topical application of 1 microgram onto the mouth parts.

1. Tentatively identified by Prof. J. A. Tuite of Purdue University.

Microfilm $2.75; Xerox $7.20. 155 pages.

A COMPARATIVE STUDY OF EMBRYONIC AND ADULT FROG ACTOMYOSIN

(Order No. Mic 61-2219)

Margit M. Kahlbrock Nass, Ph.D.
Columbia University, 1961

The changes in the enzyme characteristics of actomyosin ATPase during frog ontogeny were investigated with respect to kinetics, pH optima, effects of variations of ionic strength, divalent ions and other environmental conditions. In view of the large amounts of non-muscle proteins extracted by Weber-Edsall solution especially during early development, it was necessary to use a more specific activity index than the conventional ones. The index used, "μg P split per mg protein precipitable by adult actomyosin antibodies," was advantageous because the changes in ATPase activity in an extract could be specifically related to the small percentage of protein associated with actomyosin reactive groups.

Purification studies indicated that the solubility characteristics of embryonic actomyosin and yolk are very similar. The bulk of the yolk, however, could be separated by dissection of embryos into dorsal and yolky ventral fragments. The dorsal salt-extracted, multi-reprecipitated proteins were used in all actomyosin ATPase characterization studies. All the ATPase of this fraction was precipitated by adult anti-actomyosin serum. The salt-extracted euglobulin fraction of whole embryos remained relatively constant from fertilization to hatching and then declined sharply as yolk utilization became significant. The supernatant proteins (soluble in 0.06 M KC1) increased steadily after neurulation, especially in the dorsal fraction. Immunologically reactive groups of actomyosin were first detected in the soluble ventral and dorsal supernatant fractions at late gastrulation to neurulation and in the precipitable dorsal fraction at early tailbud stage. The quantities of actomyosin antibody precipitable protein and the associated ATPase activity per dorsal fragment increased linearly from tailbud to hatching, followed by a steeper linear rate thereafter. The non-actomyosin ATPase activity of the dorsal soluble supernatant increased similarly but at a much greater rate.

Contraction of actomyosin fibers prepared from dorsal extracts at stage 20 (hatching) was found to be 60% of the contraction of fibers from older tadpoles and adults. Fibers formed from extracts of whole embryos at stage 20 contracted to only 10% of the adult response, indicative of the yolk interference. Actomyosin antiserum completely inhibited the contraction of actomyosin fibers, but did not affect the ATPase activity of antigen-antibody precipitates.

Many enzyme characteristics of multi-reprecipitated actomyosin were found to change markedly during development of young tadpoles, reaching adult characteristics in older tadpoles. Ca^{++} and Mg^{++} activated the ATPases in both dorsal supernatant and precipitable fractions through stage 25. The Mg^{++}- and Ca^{++}-activated soluble ATPases and the Mg^{++}-activated precipitable ATPase were all detected one stage earlier than the Ca^{++}-activated precipitable ATPase. The specific activity of the Ca^{++}-enhanced actomyosin ATPase increased during development while that of the Mg^{++}-enhanced actomyosin ATPase correspondingly decreased. The sum of both activities was relatively constant from stages 17–25. Optimal activation by Ca^{++} occurred at 5×10^{-3} M at all stages, optimal activation by Mg^{++} at 5×10^{-3} M in young tadpoles and 8×10^{-4} M in older tadpoles and adults. Variations of KC1 concentrations in the presence of Ca^{++} or Mg^{++} had little effect upon stage 20 and stage 25 enzyme activities as compared with very distinct effects at later stages. Stage 20 and 25 actomyosin hydrolyzed two labile phosphate groups of ATP as compared with only one hydrolyzed by adult actomyosin. Rate curves, enzyme and substrate concentration curves in high salt were similar in tadpoles and adults, except for inhibitory effects of Mg^{++} at high substrate concentrations in the adult. Shifts in pH optima occurred during development from a single, shallow peak between pH 7 and 8 at stage 20 to two small peaks at pH 6.8 and 7.8 at stage 25, reaching adult characteristics of pH optima at pH 6.3 and 9.5 in older tadpoles, all in the presence of Ca^{++}. A shift from a pH optimum at pH 7.3 at stages 20 and 25 to an optimum at pH 6.3 in older tadpoles and adults occurred in the presence of Mg^{++}.

The results are discussed in relation to the formation and differentiation of actomyosin and are correlated with the pertinent literature. It is concluded that the rise of ATPase specific activity and the extensive enzymatic changes occurring during development are indicative of a differentiation of actomyosin.

Microfilm $2.75; Xerox $5.20. 102 pages.

COMPOSITE-FEEDING APHIDS OF THE GENUS MACROSIPHUM AND TWO CLOSELY RELATED GENERA IN NORTH CAROLINA (HOMOPTERA: APHIDAE) WITH A HOST-PLANT LIST OF MACROSIPHUM AND RELATED GENERA OF THE EASTERN UNITED STATES.

(Order No. Mic 61-2308)

Aulsey Thomas Olive, Ph.D.
North Carolina State College, 1961

Supervisor: Clyde Fuhriman Smith

The species of Dactynotus Rafinesque, Macrosiphum Passerini, and a new genus, all occurring on Compositae in North Carolina, were studied. Eight, old species are redescribed, and ten, new species are described. A host-plant list for the eastern United States is given, including

aphids which, at one time or another, have been placed under the old genus Macrosiphum. This list is divided into an aphid-host list and a host-aphid list.

Microfilm $2.75; Xerox $9.45. 209 pages.

NEMATODES ASSOCIATED WITH CARNATIONS, DIANTHUS CARYOPHYLLUS L., IN NEW JERSEY WITH SPECIAL REFERENCE TO THE PARASITISM AND BIOLOGY OF CRICONEMOIDES CURVATUM RASKI.

(Order No. Mic 61-2192)

Herbert Thomas Streu, Ph.D.
Rutgers University, 1961

Major Professor: Dr. William R. Jenkins

Little information has been available concerning plant-parasitic nematodes or their importance on the American carnation, Dianthus caryophyllus L., in New Jersey. Examination of 56 samples of soil and roots revealed that plant-parasitic, or potentially plant-parasitic, nematodes were commonly associated with this crop. The most frequently found nematodes were: Paratylenchus sp., Tylenchorhynchus dubius Butschli, and Criconemoides curvatum Raski. Although populations of parasitic nematodes as high as 99,330 per pint of soil were found, no correlation between nematode occurrence and plant condition could be made. Results also indicate that methods used by greenhouse operators for steaming the soil are inadequate.

Data from inoculation tests, the survey, and the literature indicate that the carnation is a host for at least 21 species of nematodes. Carnations may, therefore, be an excellent plant on which to maintain cultures of nematodes in the greenhouse.

The biology, host-parasite relationships, and pathogenicity of one of the important species found in the survey, Criconemoides curvatum, was investigated. Periodic recording of feeding sites on the glass sides of root-observation boxes revealed that this nematode becomes distributed throughout the soil slowly in a vertical direction. Distribution appears to be accomplished primarily by percolating water.

Photomicrographic motion pictures of the pumping action of the median esophageal bulb of C. curvatum showed that dilation of the ovoid valve was always accompanied by a corresponding depression of the sides of the bulb. The central area of the ovoid valve was more flexible than the extremities and dilated to a distance approximately equal to the length of the valve.

C. curvatum moves forward by means of contractile waves which pass from the posterior to the anterior end. Contraction of the tail preceded the propagation of a contractile wave in the vicinity of the uterus. The distance the nematode moved forward equalled the net distance of forward tail movement.

Natural groupings in the measurements of stylet lengths of 131 specimens of C. curvatum indicated that three size groupings of larval forms occur and the presence of four stages of hatched individuals.

Greenhouse pot experiments showed that the over-all effect of C. curvatum on the growth of carnation was a reduced root system. Observations at 35-day intervals showed an arithmetic increase in populations from an initial inoculum of 250 to an average of 33,200 nematodes per 8 in. pot after 209 days. There was a correspondingly lower root weight of inoculated plants at each observation. At the end of 209 days, root systems of inoculated plants were reduced 33.6%. After 141 days it was found that population densities remained at about 1,000 nematodes per gram of root. The effect of planting rooted carnation cuttings into heavily infested soils in root-observation boxes in which the nematode distribution was known, was a striking reduction in root systems. The greatest area of root reduction was in the general feeding zone in the center of the box.

Examination of sectioned and stained parasitized carnation roots showed that C. curvatum feeds on carnation roots not only as an ectoparasite, but also with the anterior end of the body embedded 2 to 3 cells deep into the cortex, and as an endoparasite. Surface cavities were observed in parasitized roots with nematodes feeding within these cavities. Root whole mounts showed nematodes embedded entirely within cortical tissue. The staining reaction of parasitized cells in root sections was consistently different from unaffected cells, indicating that some chemical change had occurred. A granular appearing, deeply stained area was always observed around the tips of stylets penetrating cells.

Microfilm $2.75; Xerox $4.20. 77 pages.

MONOGRAPH

A FACTORIAL ANALYSIS OF CLERGYMEN'S RATINGS OF CONCEPTS REGARDING WHAT IT MEANS TO BE "RELIGIOUS."

(Order No. Mic 61-1980)

John Douglas Shand, Ph.D.
University of Chicago, 1953

By studying clergymen's conceptions of what it means to be "religious," the author hoped to discover some of the basic criteria of religiousness, as they were conceived by men who had made religion their profession. Also, by having them rate these criteria of religiousness, he hoped to discover the relative importance which they attached to each of them, and to determine the degree of agreement in their evaluations.

The author first interviewed 142 ministers, rabbis, and priests, all of whom were from the Greater Chicago area, and who were selected in such a way as to represent almost every major point of view of the Protestant, Catholic, and Jewish faiths. During the interviews each clergyman was asked a series of questions designed to draw out his conceptions of what "being religious" involved.

From the extensive interview material obtained, the author culled all those ideas which the clergymen had indicated had something to do with being "religious." They numbered a total of over 2400 ideas. These ideas were subsequently classified by a group of judges into 180 distinctly different conceptions of what it means to be "religious."

In a later stage of the investigation, four groups of clergymen (not the same as those who had been interviewed initially) who again represented every major Catholic, Jewish, and Protestant point of view, were selected to rate these 180 different conceptions.

Each clergyman rated each of the concepts for its importance in defining a "religious" person. The ratings were made by means of an eleven-pile scale, with a given number of concepts (each printed on a card) to be sorted into each scale position, those conceptions which were considered by the clergymen to be least characteristic of a "religious" person being sorted toward one end of the scale, and those which were considered to be most characteristic of a "religious" person being sorted toward the other end.

When these sortings had been completed, it was then possible to correlate each clergyman's ratings of the concepts with every other clergyman's ratings, and factor analysis was used to determine in what ways the clergymen grouped themselves in their ratings of the concepts.

The results of the factor analyses indicated that there were at least five independent orthogonal factors, which meant that there were, among the clergy, essentially five basically different conceptions of what it means to be "religious," two of which were fundamentalist and three humanistic.

One group of clergymen, whom the author called a "righteous formalistic fundamentalist" group, placed emphasis on observing the "formalities" of religion (the acceptance of beliefs and creeds, ritual and tradition, and their cultivation), and traits characteristic of a righteous person. A second group of clergymen, who were called a "puritanical fundamentalist" group, placed greater emphasis than other groups on a religious person being one who doesn't drink, gamble, smoke, or swear, who is righteous, virtuous, and moral, etc.

A "humanistic" group of clergymen tended to consider a person "religious" if he had a spirit of brotherhood, was interested in human welfare, wanted better social and economic conditions, had sympathy and understanding, sought truth, was mature, fair, tolerant, and ethical, etc. A "theistic humanistic" group, while adhering to human values, placed greater emphasis on faith in God. A "religious-law observing" group, while stressing humanistic values, placed greater emphasis than other groups on observing religious traditions and ritual, laws and commandments, and participating in the activities of one's congregation.

The evidence seemed to indicate that the clergymen as a whole did not have a single general conception of what it means to be "religious" which all of them agreed upon. Nor did the clergymen adhere to distinctly different viewpoints based on specific denominational affiliation. In general, various clergymen adhered to the above-mentioned conceptions in ways which sometimes cut across denominational lines. Microfilm $2.75; Xerox $7.40. 156 pages.

The items following each abstract are: the number of manuscript pages in the dissertation and its cost on microfilm. Enlargements 5–1/2 x 8–1/2 inches, 4–1/2 cents per page.

A C T H

The synthesis of peptides related to -melanocyte stimulating hormone and the corticotropins. S. Lande. XXII, 52

ABILITY—TESTING

The effects of group counseling in a controlled workshop setting on attitude, manual dexterity and ability to perceive correct spatial relations. M. Waldman. XXII, 328

ABILITY GROUPING IN EDUCATION

Ability grouping and teacher attitudes: an exploratory study of junior high school teachers and their commitment to ability grouping. J. A. Phillips, Jr. XXII, 172

ABNORMAL CHILDREN see Handicapped children

ABSORPTION OF GASES see Gases—Absorption and adsorption

ABSORPTION SPECTRA

The electronic spectra and structures of the carboxyl group and related systems. E. E. Barnes. XXII, 86

ABSTRACT METRICS see Distance geometry

ACCELERATORS, ELECTRON see Particle accelerators

ACCENTUATION (MUSIC) see Musical accentuation

ACCIDENTS, TRAFFIC see Traffic accidents

ACCOMMODATION (PSYCHOLOGY) see Adjustment (Psychology)

ACCULTURATION

Protestant missionaries to the American Indians, 1787 to 1862. R. F. Berkhofer, Jr. XXII, 25

ACERACEAE

A blade tissue study of forty-seven species and varieties of aceraceae. H. O. Powers. XXII, 42

ACETONITRILE

Acid-base equilibria in acetonitrile. M. K. Chantooni, Jr. XXII, 44

Inorganic electrolytes in anhydrous acetonitrile. A. E. Marcinkowsky. XXII, 97

ACETYLENE

The reaction of triphenyltin hydride with the acetylenic bond. N. V. Kern. XXII, 73

ACETYLFERROCENE

Some condensations and related reactions of mono- and bis-acetylferrocenes. T. A. Mashburn, Jr. XXII, 75

ACHROMOBACTER FISCHERI

Factors affecting the interrelationships involved in protein synthesis. P. B. Hill. XXII, 29

ACHROMYCIN see Tetracycline

ACOUSTICS see Sound

ADAMS, HENRY, 1838-1918

Irony in the works of Henry Adams. H. B. Rule. XXII, 249

ADAPTATION (PSYCHOLOGY) see Adjustment (Psychology)

ADERMIN see Pyridoxine

ADJUSTMENT (PSYCHOLOGY)

Self-acceptance in relation to adjustment. D. C. Perry. XXII, 317

ADRENALIN

The effects of epinephrine, chlorpromazine, and dibenzyline upon the fright responses of rats under stress and non-stress conditions. J. E. Singer. XXII, 318

ADRENOCORTICOTROPIC HORMONES see ACTH

ADSORPTION OF GASES see Gases—Absorption and adsorption

ADULT EDUCATION see Education of adults

AERODYNAMIC HEATING

Combined free and forced convection from rotating bodies of revolution. R. G. Hering. XXII, 213

AERODYNAMICS, SUPERSONIC

Study of three-dimensional supersonic flow problems by a numerical method based on the method of characteristics (specially adapted for use on high speed electronic digital computers). C. C. Tsung. XXII, 187

AEROFOILS

Torsional stiffness of non-uniformly heated cantilever plates for any aspect ratio and initial twist. D. W. Breuer. XXII, 187

AEROLITES see Meteorites

AFFECTION see Friendship

AGGRESSIVENESS (PSYCHOLOGY)

A comparative study of self-perceptions of aggressive and withdrawn children. E. M. Morgan. XXII, 163

AGRARIAN QUESTION see Agriculture—Economic aspects

AGRICULTURAL COLONIES—BRITISH HONDURAS

Agricultural settlement in British Honduras: a geographic interpretation of its development. A. D. Bushong. XXII, 223

AGRICULTURAL COOPERATIVE CREDIT ASSOCIATIONS—U. S.

Competition between commercial banks and a production credit association: a case study. K. D. Patterson. XXII, 108

AGRICULTURAL ECONOMICS see Agriculture—Economic aspects

AGRICULTURAL ENGINEERING

The needs of dairy farmers in agricultural mechanics in selected dairy counties of New York. W. H. Annis. XXII, 121

AGRICULTURE—ECONOMIC ASPECTS—INDIA

Increasing income and production in Indian farming: possibilities with the existing resource supplies on individual farms. D. K. Desai. XXII, 111

AGRICULTURE—ECONOMIC ASPECTS—NORTH CAROLINA

An economic appraisal of farming adjustment opportunities to meet changing conditions in Economic Area 7, North Carolina. R. L. Rizek. XXII, 113

AGRICULTURE—BRITISH HONDURAS

Agricultural settlement in British Honduras: a geographic interpretation of its development. A. D. Bushong. XXII, 223

AGRICULTURE—MEXICO—YUCATAN

Some geographic aspects of plantation agriculture in Yucatan. R. E. P. Chardon. XXII, 223

AGROSTOLOGY see Grasses

AIR FORCE see U. S. Air Force

AIRFOILS see Aerofoils

ALBUMIN

A study of certain physical and chemical properties of chicken eggs in relation to their initial albumen quality and to some characteristics of the hens which laid them. J. H. Skala. XXII, 221

ALDEHYDES

Aldehydes and bases in the Darzens condensation. C. G. Carlile. XXII, 67

ALDOLASE

A thermophilic aldolase: purification and partial characterization. P. J. Thompson. XXII, 31

ALEXINS see Complements (Immunity)

ALFALFA

Character association analysis in alfalfa. A. Jones. XXII, 34

The effect of phosphorus and potassium on the botanical and chemical composition, yield, and persistence of alfalfa and certain grasses grown in combination. J. N. Pratt. XXII, 18

The response of alfalfa to defoliation by grazing animals as compared to clipping. D. M. Gossett. XXII, 15

ALGEBRA OF LOGIC see Logic, Symbolic and mathematical

ALGEBRAIC IDEALS see Ideals (Algebra)

ALKALI PROTEINASE see Trypsin

ALKENES see Olefines

ALKYL BROMIDES

Studies of certain fluorine-containing alkyl bromides. R. D. Battershell. XXII, 64

ALKYLBENZENE

Part I: Studies of the decomposition of tetra-substituted phosphonium alkoxides. Part II: Copper ion-catalyzed reactions of t-butyl perbenzoate with alkylbenzenes. L. J. Ross. XXII, 78

ALLEYS see Streets

ALLIGATOR-PEAR see Avocado

ALPHA RAYS—SCATTERING

Nuclear reaction studies at intermediate energies. (Parts I and II). D. K. McDaniels. XXII, 293

ALTITUDE, INFLUENCE OF

Respiration and phosphorylation in heart and liver mitochondria isolated from altitude acclimatized rats. E. H. Strickland, Jr. XXII, 56

ALUMINUM-COPPER ALLOYS

The structure of a Guinier-Preston zone. A. D. Thomas, Jr. XXII, 217

ALUMINUM OXIDE CRYSTALS

Internal friction in aluminum oxide single crystals. R. J. Huber. XXII, 299

AMERICAN CHURCH HISTORIANS see Church historians, American

AMERICAN INDIANS see Indians of North America

AMERICAN NATIONAL CHARACTERISTICS see National characteristics, American

AMERICAN QUOTATIONS see Quotations, American

AMETUS, EPISTOLA DE PROPORTIONE ET PROPORTIONALITATE

The Epistola de proportione et proportionalitate of Ametus Filius Iosephi. Sister M. W. R. Schrader, O. P. XXII, 272

AMINO ACIDS

The syntheses and properties of some benzimidazolyl amino acids. L. A. Cescon. XXII, 68

AMINOLEVULINIC ACID

The biosynthesis of the corrin moiety of vitamin B_{12} from methionine and δ-aminolevulinic acid. R. C. Bray. XXII, 48

AMPHIMIXIS see Reproduction

ANABAPTISTS—DOCTRINAL AND CONTROVERSIAL WORKS

The development of Dutch Anabaptist thought and practice from 1539-1564. W. E. Keeney. XXII, 341

ANABAPTISTS—NETHERLANDS

The development of Dutch Anabaptist thought and practice from 1539-1564. W. E. Keeney. XXII, 341

ANABOLISM see Metabolism

ANALYSIS, CHROMATOGRAPHIC see Chromatographic analysis

ANALYSIS SITUS see Topology

ANCESTRY see Heredity

ANELASTICITY see Internal friction

ANGLICAN CHURCH see Church of England

ANGLO-SAXON LANGUAGE—SEMANTICS

A study of Old English words for demon and monster and their relation to English place-names. R. A. Peters. XXII, 253

ANGLO-SAXON LANGUAGE—WORDS—HISTORY

A study of Old English words for demon and monster and their relation to English place-names. R. A. Peters. XXII, 253

ANIMAL HEAT

Heat and moisture production of mature leghorn chickens. H. V. Walton. XXII, 190

ANIMAL PSYCHOLOGY see Psychology, Comparative

ANIMALS, AQUATIC see Marine fauna

ANIMALS, RESPIRATION OF see Respiration

ANTHRACENE

I. Polymerization of some cyclic, non-conjugated diolefins. II. An attempted synthesis of an ethylene-anthracene copolymer. R. Z. Greenley. XXII, 71

ANTHRACITE COAL

The unsteady state diffusion of gases from anthracite at high temperatures. E. T. Nelson. XXII, 199

ANTIGENS AND ANTIBODIES

Requirement of avian C'1 for fixation of guinea pig complement by avian antibody-antigen complexes. H. N. Benson. XXII, 7

ANTIMETABOLITES

The synthesis of some phenyl(2-hydroxy-3-pyrazyl)carbinols as possible antimetabolites of serotonin. V. S. Venturella. XXII, 85

ANTI-NAZI MOVEMENT IN LITERATURE

Antinationalsozialistische Gestalten im deutschen Nachkriegsroman. [German text] J. Kempers. XXII, 261

ANTIQUITIES, ECCLESIASTICAL see Christian antiquities

ANXIETY

The effects of group counseling on interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics in a planned workshop experience. M. Reiser. XXII, 325

APPALACHIAN MOUNTAINS, SOUTHERN—RELIGION

Religious beliefs and social status: a study of the relationship between religious beliefs and social status levels in sixty-one churches of the Southern Appalachian Mountains. A. K. Jackson. XXII, 340

APPALACHIAN MOUNTAINS, SOUTHERN—SOCIAL CONDITIONS

Religious beliefs and social status: a study of the relationship between religious beliefs and social status levels in sixty-one churches of the Southern Appalachian Mountains. A. K. Jackson. XXII, 340

APPLE

Demand and spatial equilibrium models for fresh apples in the United States. W. H. Drew. XXII, 112

I. The partial purification and properties of a germination inhibitor(s) isolated from apple seed. II. Pyrimidine metabolism in germinating seedlings. W. R. Evans. XXII, 49

APPRAISAL OF BOOKS see Criticism

APPRECIATION OF ART see Art—Study and teaching

APPREHENSION see Perception

APPRENTICES—MICHIGAN

An investigation of factors considered in the selection of apprentices by manufacturing companies in Michigan. R. H. Hagemeyer. XXII, 124

APPROXIMATE COMPUTATION

Asymptotic methods of evaluating $\int_a^\infty f(x)dx$. W. Richardson. XXII, 272

Numerical methods of approximation with application to electrical network design. R. R. Kenyon. XXII, 209

APTITUDE TESTS see Ability—Testing

APYRASE

Low temperature tolerance of insects in relation to the influence of temperature on muscle apyrase activity. J. A. Mutchmor. XXII, 304

AQUATIC ANIMALS see Marine fauna

ARABIC LANGUAGE—DIALECTS—LEBANON

Effects of the second formant in the perception of velarization in Lebanese Arabic. D. H. Obrecht. XXII, 252

ARABIC LANGUAGE—PHONETICS

Phonetics in early Islam: the speech-sounds. K. I. H. Semaan. XXII, 253

ARABIC LANGUAGE—PHONOLOGY

Effects of the second formant in the perception of velarization in Lebanese Arabic. D. H. Obrecht. XXII, 252

ARCHAEOLOGY, CHRISTIAN see Christian antiquities

ARCHANGIUM

Studies on two species of the genus Archangium (Myxobacterales). J. C. McDonald, Jr. XXII, 42

ARCHITECTURAL ENGINEERING see Strains and stresses; Structures, Theory of

ARGUMENTATION see Reasoning

ARISTOCRACY IN LITERATURE

The aristocrat in the Spanish novel of the naturalistic period. H. E. Lewald. XXII, 262

ARITHMETIC—STUDY AND TEACHING (ELEMENTARY)

The effect of reinforcement in teaching arithmetic on the performance of fifth grade students. B. Davis. XXII, 178

The effect of the use of a particular method on achievement in problem solving in sixth grade arithmetic. C. J. Faulk. XXII, 122

ARNOLD, MATTHEW, 1822-1888

Matthew Arnold as satirist. J. B. Lott. XXII, 248

ARNOLD, MATHEW, 1822-1888—RELIGION AND ETHICS

The critical reception of Arnold's poetry: the religious issue. N. T. Francis. XXII, 259

AROMATIC COMPOUNDS

Reactions of ferric chloride with aromatic compounds. C. Wu. XXII, 84

ART

Comments on art and literature from the personal writings of a group of well traveled, early American writers and artists. A critical collation. J. J. Lawler. XXII, 262

ART—STUDY AND TEACHING

The effect of certain teaching methods on college students' art attitudes and appreciations. E. A. Annis. XXII, 176

ART—STUDY AND TEACHING—U. S.

The contributions of Horace Mann, Mary Peabody Mann, and Elizabeth Peabody to art education in the United States. R. J. Saunders. XXII, 143

ART AND RELIGION

The relationship of certain religious attitudes to artistic behavior. J. P. Roy. XXII, 184

ART APPRECIATION see Art—Study and teaching

ART EDUCATION see Art—Study and teaching

ARTHROPODA

Conditions for the culture of arthropod tissues. J. A. P. Haskell. XXII, 367

ARYTENOID LIGAMENTS see Vocal cords

ASCORBIC ACID

The influence of hypothyroidism and chorionic gonadotrophin on ovarian and adrenal ascorbic acid in the rat. R. P. Blye. XXII, 364

ASSYRIA—COLONIES

Assyrian colonies in Cappadocia. L. L. Orlin. XXII, 235

ASTROPHYSICS

Energy loss mechanisms from very dense stars. R. C. Stabler. XXII, 295

ATOMIC PILES see Nuclear reactors

ATOMS—SPACE ARRANGEMENT see Stereochemistry

ATONALITY see Tonality

ATTITUDE (PSYCHOLOGY)

The effects of group counseling in a controlled workshop setting on attitude, manual dexterity and ability to perceive correct spatial relations. M. Waldman. XXII, 328

A study of attitude changes in theological students during one year of seminary training. R. A. Proctor, Jr. XXII, 343

AUDIO-VISUAL EDUCATION

A comparative study on the effectiveness of the filmstrip, sound filmstrip, and filmograph for teaching facts and concepts. R. J. McBeath. XXII, 161

AUDIOMETRY

Human discrimination of auditory duration. C. D. Creelman. XXII, 331

A study of single automatic and single manual trial audiometry. W. Melnick. XXII, 360

AUTHORITY

An analysis of authority and power in administration. J. M. Hanlon. XXII, 137

AUTOMATIC CONTROL

Parameter tracking and adaptive control systems. N. N. Puri. XXII, 211

AUTOMATIC DIGITAL COMPUTERS see Electronic digital computers

AUTOMOBILE ACCIDENTS see Traffic accidents

AUTOMOBILE DRIVERS—PSYCHOLOGY

Personality differences and similarities between offender and non-offender Air Force motor vehicle operators. W. J. Hubert. XXII, 156

AVOCADO

An evaluation of consumer preference and the effects of price variations and selected fruit characteristics on retail sales of Florida avocados. F. W. Williams. XXII, 114

BACILLUS AMYLOVORUS

Studies on the nutrition of bartlett pear trees (Pyrus communis L.) and fire blight (Erwinia amylovora, Burr.). L. N. Lewis XXII, 16

BACILLUS ANTHRACOIDES see Bacillus megatherium

BACILLUS BRASSICAE see Bacillus megatherium

BACILLUS COAGULANS

Properties of flagella obtained from the facultative thermophile Bacillus coagulans strain 43 P. K. A. Fry. XXII, 28

Thermostability and molecular differences in bacterial flagella. S. M. Friedman. XXII, 28

BACILLUS COLI COMMUNIS

The catabolism of gluconate in Escherichia coli. D. E. Jones. XXII, 52

Factors affecting the interrelationships involved in protein synthesis. P. B. Hill. XXII, 29

BACILLUS DEXTROLACTICUS see Bacillus coagulans

BACILLUS FLUORESCENS LIQUEFACIANS see Pseudomonas fluorescens

BACILLUS MEGATHERIUM

Factors affecting the interrelationships involved in protein synthesis. P. B. Hill. XXII, 29

BACILLUS SESSILIS see Bacillus megatherium

BACILLUS STEAROTHERMOPHILUS

A thermophilic aldolase: purification and partial characterization. P. J. Thompson. XXII, 31

BACILLUS THERMOACIDURANS see Bacillus coagulans

BACTERIOLOGY

Commensal bacteria of marine animals — a study of their distribution, physiology and taxonomy. R. B. R. Colwell. XXII, 26

BACTERIUM TULARENSE

The effect of infection with pasteurella tularensis on the metabolism of white rats. G. J. Miraglia. XXII, 31

BALL STATE TEACHERS COLLEGE, MUNCIE, IND. see Indiana. Ball State Teachers College, Muncie

BALMER SERIES

Profile of the H-gamma line in the white dwarf 40 eridani B. J. D. Fuller. XXII, 26

BALTIMORE—WATER-SUPPLY

Joint operation of gravity reservoirs and pumped supplies. M. J. Willis. XXII, 219

BAPTISTA MANTUANUS, 1448-1516

Baptista Mantuanus, Carmelite humanist. W. E. Painter. XXII, 240

BAPTISTS—EDUCATION

An investigation of the training needs of lay religious educators in conservative Baptist churches in southern Michigan. D. E. Gillespie. XXII, 169

BARIUM—ISOTOPES

Directional correlation of successive gamma rays in Ba^{136} and Mo^{94}. H. Bernstein. XXII, 290

BARIUM TITANATE CRYSTALS

A study of the aging phenomenon in barium titanate single crystals. R. D. Baba. XXII, 296

BARTH, KARL, 1886-

Objective and subjective in Karl Barth's doctrine of reconciliation. P. H. Gertmenian. XXII, 339

BARTHIANISM see Dialectical theology

BASE-EXCHANGE see Ion exchange

BEAMS see Girders

BEAN LADYBIRD see Mexican bean beetle

BEANS

Morphological and developmental changes in the bean Phaseolus vulgaris L. as modified by the application of various growth regulators. J. S Vandemark. XXII, 19

BELGIUM—CONSTITUTIONAL HISTORY

The Belgian royal question, 1940-1950: cleavage and consensus in society and politics. E. R. Arango. XXII, 307

BELGIUM—KINGS AND RULERS

The Belgian royal question, 1940-1950: cleavage and consensus in society and politics. E. R. Arango. XXII, 307

BELGIUM—POLITICS AND GOVERNMENT—1914-

The Belgian royal question, 1940-1950: cleavage and consensus in society and politics. E. R. Arango. XXII, 307

BELLES-LETTRES see Literature

BENEVOLENT INSTITUTIONS see Charities

BENZYL ALCOHOLS

The kinetics of oxygen exchange of substituted benzyl alcohols as a function of acidity. D. A. Jeffrey. XXII, 72

BERYLLIUM

Fast-neutron total cross sections of beryllium, carbon, and oxygen. D. B. Fossan. XXII, 291

BIBLE. N. T. JOHN—LANGUAGE, STYLE

Structure and theology in the Fourth Gospel: a study of literary features in the Fourth Gospel and their relation to its theology. D. M. Granskou. XXII, 339

BIBLE. N. T. JOHN—THEOLOGY

Structure and theology in the Fourth Gospel: a study of literary features in the Fourth Gospel and their relation to its theology. D. M. Granskou. XXII, 339

BIBLIOGRAPHY, CRITICAL see Criticism

BIOSYNTHESIS

Factors affecting the interrelationships involved in protein synthesis. P. B. Hill. XXII, 29

BIRDS—NORTH CAROLINA

The populations, habitat relations and ecological changes in the winter birds of the Raleigh, North Carolina, region, 1880-1959. J. B. Funderburg, Jr. XXII, 366

BIRTH CONTROL—U. S.

Content analysis of middle class women's fiction from 1901 to 1960 as indicative of changing cultural values related to middle class birthrates. E. V. Smith. XXII, 354

BITUMINOUS COAL

Major economic changes in the mining and distribution of Pennsylvania bituminous coal. J. N. Hoffman. XXII, 107

Reaction of bituminous coal with concentrated sulfuric acid. M. P. Thomas. XXII, 202

BLAKE, WILLIAM, 1757-1827

The idea of nature in the poetry of William Blake. L. A. Waters, Jr. XXII, 265

BLOOD—SERUM see Serum

BLUEBERRIES—DISEASES AND PESTS

Blueberry stem blight caused by Botryosphaeria dothidea. W. Witcher. XXII, 23

BOARDS OF EDUCATION see School boards

BODY OF REVOLUTION

Combined free and forced convection from rotating bodies of revolution. R. G. Hering. XXII, 213

BODY TEMPERATURE

The influence of ambient temperature on early pregnancy loss as determined by embryo transfer. C. W. Alliston. XXII, 301

BOILING-POINTS

An investigation of boiling with single and parallel channel flow. J. D. Roarty. XXII, 215

BONDS

A historical study of the effects of inflation on the market for bonds. R. T. Mullins. XXII, 120

BOOKS—APPRAISAL see Criticism

BORANE

Solvolysis kinetics of pyridine-boranes. E. R. Birnbaum. XXII, 58

BORDETELLA BRONCHISEPTICA

Bordetella bronchiseptica induced porcine atrophic rhinitis. R. F. Cross. XXII, 233

BORON HYDRIDE see Borane

BOTANY—VARIATION

Variation in loblolly pine (Pinus taeda L.). E. Thorbjornsen. XXII, 11

BOTRYOSPHAERIA DOTHIDEA

Blueberry stem blight caused by Botryosphaeria dothidea. W. Witcher. XXII, 23

BOUNDARY LAYER

Interaction of a shock wave with a step boundary layer of high sound speed gas. R. L. Haslund. XXII, 288

BOUNDARY VALUE PROBLEMS

Extensions and applications of the method of finite transforms. S. Kaplan. XXII, 214

BOURGUÈS, LUCIEN. LA MUSIQUE ET LA VIE INTÉRIEURE

A translation and critique of La musique et la vie intérieure by Lucien Bourguès and Alexandre Denéréaz (a psycho-musico-aesthetic study) parts I-III. G. B. Merchant. XXII, 281

BRACKISH WATER FAUNA see Marine fauna

BRAIN—INFLAMMATION

Host cell-virus interactions in cultures of mammalian cells infected with Japanese encephalitis virus. D. R. M. Dubbs. XXII, 27

BRAZILIAN CLOVER see Alfalfa

BREADSTUFFS see Wheat

BREAST—CANCER

The effect of chemically-defined media upon tissue cultures of skin, cystic disease and carcinomas from the human female breast. M. F. Orr. XXII, 24

BREATHING see Respiration

BREVIBACTERIUM LINENS

A comparative study of some endocellular proteolytic enzymes of an oxidative type yeast. R. L. Maginnis. XXII, 31

BRINE see Salt

BUBBLES

Mass transfer and velocity of rise phenomena for single bubbles. J. H. Leonard. XXII, 197

BUFFING see Grinding and polishing

BULLS

Reproductive physiology of the male bovine. R. P. Amann. XXII, 7

BUSINESS—REMOVAL see Industries, Location of

BUTADIINE see Acetylene

BUTYL PERBENZOATE

Part I: Studies of the decomposition of tetra-substituted phosphonium alkoxides. Part II: Copper ion-catalyzed reactions of t-butyl perbenzoate with alkylbenzenes. L. J. Ross. XXII, 78

CAFFEIN—PHYSIOLOGICAL EFFECT

Effects of caffeine on the physiology and chromosome behavior of the ciliate, Tetrahymena pyriformis. J. D. Eisen. XXII, 302

CALIFORNIA—CIVILIAN DEFENSE

The organization and administration of civil defense in California public schools. R. Hubert. XXII, 138

CALOR ANIMALIS see Animal heat

CAPITAL AND LABOR see Industrial relations

CAPPADOCIA—HISTORY

Assyrian colonies in Cappadocia. L. L. Orlin. XXII, 235

CARBINOLS

The synthesis of some phenyl(2-hydroxy-3-pyrazyl)carbinols as possible antimetabolites of serotonin. V. S. Venturella. XXII, 85

CARBON

The effect of mass transport on the carbon-carbon dioxide reaction. L. G. Austin. XXII, 191

Fast-neutron total cross sections of beryllium, carbon, and oxygen. D. B. Fossan. XXII, 291

The radiation induced exchange of carbon between ethane and methyl amine. P. S. Lamprey. XXII, 95

CARBON DIOXIDE

The effect of mass transport on the carbon-carbon dioxide reaction. L. G. Austin. XXII, 191

CARBON GASIFICATION

Surface effects on the low temperature gasification of carbons. A. F. Armington. XXII, 190

CARBON MONOXIDE

Formation of negative ions in CO by charge transfer. F. Hushfar. XXII, 288

A variable frequency spectrophone study of carbon monoxide. W. E. Woodmansee. XXII, 105

CARBONATES

The ionic nature of molten alkali carbonates. M. R. Lorenz. XXII, 96

CARBONIC ACID see Carbon dioxide

CARBONIC OXIDE see Carbon monoxide

CARBONIUM

Rates of reaction of cyclopropyl and phenyl substituted ketones with sodium borohydride: ketone reactivity as a model for carbonium ion stability. R. Bernheimer. XXII, 65

CARBONYL CYANIDE

Part I: Synthetic approaches to tetracyclines. Part II: Mechanism of the reaction of carbonyl cyanide with olefins. Part III: Alkylation of dienamines. G. I. Birnbaum. XXII, 65

CARBOXYL GROUP

The electronic spectra and structures of the carboxyl group and related systems. E. E. Barnes. XXII, 86

CARCINOMA see Tumors

CARNATIONS—DISEASES AND PESTS

Nematodes associated with carnations, Dianthus caryophyllus L., in New Jersey with special reference to the parasitism and biology of Criconemoides curvatum Raski. H. T. Streu. XXII, 369

CASE STUDIES see subdivision Case studies under specific subjects, e. g. Industries, Location of—Case studies; Local finance—Case studies; Social status—Case studies; United States—Race question—Case studies

CASEIN

A comparative study of some endocellular proteolytic enzymes of an oxidative type yeast. R. L. Maginnis. XXII, 31

CATABAPTISTS see Anabaptists

CATABOLISM see Metabolism

CATTLE

Methods of determining thyroid secretion rates in dairy cattle. T. B. Post. XXII, 305

CATTLE—FEEDING AND FEEDS

Re-entrant duodenal fistula techniques: application to the study of digestion and passage in the bovine alimentary tract. A. D. McGilliard. XXII, 304

CELLULASE

Study of cellulase from rumen bacteria and from Ruminococcus albus. J. M. Leatherwood. XXII, 53

CENTRALIZATION OF SCHOOLS see Schools—Centralization

CERTAINTY see Probabilities

CERTIFICATION OF SCHOOL SUPERINTENDENTS AND PRINCIPALS see School superintendents and principals—Certification

CHAIN REACTION PILES see Nuclear reactors

CHANGE, SOCIAL see Social change

CHARACTERISTICS see National characteristics

CHARGED PARTICLE ACCELERATORS see Particle accelerators

CHARITIES—SOCIETIES, ETC.

Volunteer and staff participation in a voluntary social welfare association in the United States: a study of the National Young Women's Christian Association. A. C. Almanzor. XXII, 349

CHELATES

Studies in coprecipitation. W. P. Tappmeyer. XXII, 62

CHEMICAL COMPOSITION OF THE EARTH see Geochemistry

CHEMICAL ENGINEERING

Effects of particle size distribution on saltation velocity and bin flow. F. A. Zenz. XXII, 204

Heat and momentum transfer in the incompressible boundary layer on a flat plate. O. T. Hanna. XXII, 195

A new correlation for direct contact heat transfer coefficients in baffle and perforated plate towers. D. A. Winkler. XXII, 203

Power absorption of Bingham plastics in rotational devices. R. H. Schwaar. XXII, 201

Some theoretical and experimental aspects of gas-liquid partition chromatography. J. E. Funk. XXII, 194

CHEMICAL EQUILIBRIUM

Acid-base equilibria in acetonitrile. M. K. Chantooni, Jr. XXII, 44

Donnan membrane equilibrium studies of a polyelectrolyte and a polysoap derived from poly-4-vinylpyridine. D. B. Fraser. XXII, 91

CHEMICAL EQUILIBRIUM (Continued)

Inductive and isotope effects in gas phase Lewis acid-base equilibria. P. Love. XXII, 96

Studies in equilibrium polymerization. A. Eisenberg. XXII, 89

CHEMICAL GEOLOGY see Geochemistry

CHEMICAL REACTION, RATE OF

The effect of mass transport on the carbon-carbon dioxide reaction. L. G. Austin. XXII, 191

Non-isothermal reaction kinetics. The dehydration of calcium oxalate monohydrate and thermal decomposition of calcium carbonate in the solid state. E. S. Freeman. XXII, 92

A study of the kinetics of the reactions of the chloropyridines and the chloropyridine N-oxides with sodium methoxide in methanol. R. J. Boxer. XXII, 66

Unimolecular reaction rate theory and applications. G. M. Wieder. XXII, 104

CHEMICAL REACTIONS

The stereochemistry of some reactions in a bridged polycyclic system. The stereochemistry of solvent-cage reactions. W. C. Firth, Jr. XXII, 70

CHEMISTRY, INDUSTRIAL see Chemical engineering

CHEMISTRY, ORGANIC

The mechanism of deoxymercuration and structure of mercurials in solution. L. L. Schaleger. XXII, 78

Particle-particle interaction in organic media. J. P. Wightman. XXII, 83

Part I: The structure and properties of acid soaps. Part II: The micellar properties of acid soaps in aqueous systems. S. Spring. XXII, 82

CHEMISTRY, ORGANIC—SYNTHESIS

Nucleophilic substitution in halogenated aromatic and vinylic systems. J. A. Sedlak. XXII, 79

Syntheses and characterization of some 3, 4, 5-trimethoxybenzoyl; 3, 4, 5-trimethoxybenzyl; and 3, 4, 5-trimethoxyphenylethyl derivatives of piperazine and some related compounds. B. Silverman. XXII, 80

The syntheses of isomeric alkylperylenes and the perylene monocarboxylic acids. H. E. Zieger. XXII, 84

CHEMISTRY, PHYSICAL AND THEORETICAL

Donnan membrane equilibrium studies of a polyelectrolyte and a polysoap derived from poly-4-vinylpyridine. D. B. Fraser. XXII, 91

Electron spin resonance spectroscopy in irradiated polypropylenes. T. Buch. XXII, 88

Exciton theory: application to H-bonded complexes. M. A. El-Bayoumi. XXII, 90

Heat capacity and related thermodynamic properties of Ta_2H and $DyCo_5$. W. G. Saba. XXII, 101

The ionic nature of molten alkali carbonates. M. R. Lorenz. XXII, 96

Kinetics and mechanism of the protonolysis of the tin-hydrogen bond. P. L. Levins. XXII, 95

Non-isothermal reaction kinetics. The dehydration of calcium oxalate monohydrate and thermal decomposition of calcium carbonate in the solid state. E. S. Freeman. XXII, 92

Part I. The visible spectrum of the gallium monohydride molecule. Part II. An evaluation of the coriolis interaction in asymmetric top molecules. M. L. Ginter. XXII, 93

CHEMISTRY, SYNTHETIC see Chemistry, Organic—Synthesis

CHERRY—DISEASES AND PESTS

Seed and pollen transmission of cherry ring spot virus in buttercup squash. C. Das. XXII, 20

CHICKENS see Poultry

CHILD STUDY

Differences between children who spontaneously outgrew and children who retained functional articulation errors. S. Dickson. XXII, 151

Parental recall of aspects of child development and of child-rearing practices. L. C. Robbins. XXII, 348

Some effects of maternal inconsistency and emotionality level upon offspring behavior and development. D. R. Ottinger. XXII, 324

CHILDREN—MANAGEMENT

Parental recall of aspects of child development and of child-rearing practices. L. C. Robbins. XXII, 348

CHILDREN—TRANSPORTATION see School children—Transportation

CHILDREN, ABNORMAL AND BACKWARD see Handicapped children

CHILDREN AS ARTISTS

The relationship between a test of visual sensitivity and judged qualities of children's drawings. F. Bedogne, Jr. XXII, 149

CHILEAN CLOVER see Alfalfa

CHINONE see Quinone

CHLORANIL

The crystal and molecular structure of chloranil. S. S.-C. Y. Chu. XXII, 88

CHLORIDES

A spectrophotometric determination of rhodium with s-diphenylcarbazone. Complexes of rhodium, tin, and chloride. F. L. Johnson, Jr. XXII, 46

CHLORINATION

A kinetic study of the chlorination of unbleached kraft pulp. V. D. Chapnerkar. XXII, 192

CHLOROPYRIDINE

A study of the kinetics of the reactions of the chloropyridines and the chloropyridine N-oxides with sodium methoxide in methanol. R. J. Boxer. XXII, 66

CHLORPROMAZINE

The effects of epinephrine, chlorpromazine, and dibenzyline upon the fright responses of rats under stress and non-stress conditions. J. E. Singer. XXII, 318

CHRESTOMATHIES see Readers and speakers

CHRISTIAN ANTIQUITIES—CRETE

Early Christian inscriptions of Crete. A. C. Bandy. XXII, 251

CHRISTIAN ARCHAEOLOGY see Christian antiquities

CHRISTIAN EDUCATION see Religious education

CHRISTIAN LIFE

A factorial analysis of clergymen's ratings of concepts regarding what it means to be "religious". [A monograph]. XXII, 371

CHRISTIANITY—HISTORY see Church history

CHRISTIANITY AND WAR see War and religion

CHRISTIANS OF ST. THOMAS see St. Thomas Christians

CHROMATOGRAPHIC ANALYSIS

Some theoretical and experimental aspects of gas-liquid partition chromatography. J. E. Funk. XXII, 194

CHRONDRIOSOMES see Mitochondria

CHRONOPHOTOGRAPHY see Cinematography

CHRONOPOTENTIOMETRY

Studies in chronopotentiometry. A. C. Testa XXII, 102

CHURCH—HISTORY OF DOCTRINES

The community of faith and the word: an inquiry into the concept of the church in contemporary Lutheranism. K. S. Knutson. XXII, 342

CHURCH AND WAR see War and religion

CHURCH ANTIQUITIES see Christian antiquities

CHURCH HISTORIANS, AMERICAN

Enlightenment church history in the United States, 1800-1850. R. R. Clemmer. XXII, 236

CHURCH HISTORY—HISTORIOGRAPHY

Enlightenment church history in the United States, 1800-1850. R. R. Clemmer. XXII, 236

CHURCH MISSIONARY SOCIETY

The C. M. S. Mission of Help to the Syrian Church in Malabar, 1816-1840: a study in Protestant-Eastern Orthodox encounter. E. L. Ten Brink. XXII, 241

CHURCH OF ENGLAND—RELATIONS—ORTHODOX EASTERN CHURCH

The C. M. S. Mission of Help to the Syrian Church in Malabar, 1816-1840: a study in Protestant-Eastern Orthodox encounter. E. L. Ten Brink. XXII, 241

CHURCH SCHOOLS

A study of the guidance resources of students in high schools affiliated with the National Union of Christian Schools in Michigan and Illinois. L. J. Harvey. XXII, 153

CINEMATOGRAPHY—HISTORY

A historical study of the development of American motion picture content and techniques prior to 1904. R. A. Sanderson. XXII, 235

CITIES AND TOWNS—PLANNING—PITTSBURGH

The pattern of community leadership in urban redevelopment: a Pittsburgh profile. A. J. Auerbach. XXII, 349

CITIES AND TOWNS—PLANNING—U. S.

Planning for industrial development: with empnasis on the metropolitan area. C. J. Wingfield. XXII, 316

CITY TRAFFIC

Evaluation of major urban intersections. W. W. Schenler. XXII, 207

CIVIL ENGINEERING AS A PROFESSION see Engineering as a profession

CIVIL LAW—ROME see Roman law

CLASSICAL DANCING see Modern dance

CLASSIFICATION OF SCHOOL CHILDREN see Ability grouping in education

CLERKS

Some environmental influences on food habits of women clerical workers. A. J. Bricker. XXII, 242

CLOTHING AND DRESS

Clothing values and their relation to general values and to social security and insecurity. M. Lapitsky. XXII, 244

COAL

A phenomenological approach to the batch grinding of coals. R. P. Gardner. XXII, 194

The radiation chemistry of coal in various atmospheres. A. Weinstein. XXII, 203

COAL DUST

A study of coal dust control in power plants. C. W. Krusé. XXII, 233

COAL MINES AND MINING—PENNSYLVANIA

Major economic changes in the mining and distribution of Pennsylvania bituminous coal. J. N. Hoffman. XXII, 107

COAL TRADE—PENNSYLVANIA

Major economic changes in the mining and distribution of Pennsylvania bituminous coal. J. N. Hoffman. XXII, 107

COBALT—ISOTOPES

The effects of cobalt 60 gamma radiation on microsporogenesis and male gametophyte development in tomato (Lycopersicon esculentum Mill.). M. Singh. XXII, 38

COCKSFOOT GRASS see Orchard grass

CODETERMINATION (INDUSTRIAL RELATIONS) see Employees' representation in management

COLLECTIVE SETTLEMENTS—RUSSIA

The Soviet communes. R. G. Wesson. XXII, 311

COLLEGE STUDENTS see Students

COLLEGE TEACHERS, RATING OF

A study of student-instructor relationship at the college level. C. L. Krathwohl. XXII, 125

COLLINGWOOD, ROBIN GEORGE, 1889-1943

The development of R. G. Collingwood's theory of history. H. DeLong. XXII, 285

COLLISIONS, AUTOMOBILE see Traffic accidents

COLOR-SENSE

Comparison of monocular and binocular color matching. C. S. Hoffman. XXII, 332

COLORADO. UNIVERSITY—STUDENTS

A study of personnel data as predictors of behavior of transfer students at the University of Colorado. R. L. Nash. XXII, 164

COMMERCIAL EMPLOYEES see Clerks

COMMERCIAL POLICY

Equality of treatment and trade discrimination in international law: a study. K. Hasan. XXII, 313

COMMON SCHOOLS see Public schools

COMMUNAL SETTLEMENTS see Collective settlements

COMMUNICATION

Communication and marital interaction: an exploratory study. H. E. Buchanan. XXII, 243

COMMUNICATION THEORY see Information theory

COMMUNISTIC SETTLEMENTS see Collective settlements

COMMUNITY COLLEGES see Municipal universities and colleges

COMMUNITY LEADERSHIP

The pattern of community leadership in urban redevelopment: a Pittsburgh profile. A. J. Auerbach. XXII, 349

COMPACTION OF SOILS see Soil stabilization

COMPARATIVE PSYCHOLOGY see Psychology, Comparative

COMPENSATION see Wages

COMPETITIVE ANTAGONISTS (METABOLISM) see Antimetabolites

COMPLEMENTS (IMMUNITY)

Requirement of avian C'1 for fixation of guinea pig complement by avian antibody-antigen complexes. H. N. Benson. XXII, 7

COMPOSITAE—DISEASES AND PESTS

Composite-feeding aphids of the genus Macrosiphum and two closely related genera in North Carolina (Homoptera: aphidae) with a host-plant list of Macrosiphum and related genera of the Eastern United States. A. T. Olive. XXII, 368

COMPULSORY SCHOOL ATTENDANCE see Educational law and legislation

CONCENTRATION OF SCHOOLS see Schools—Centralization

CONCORDIA TEACHERS COLLEGE, SEWARD, NEB.

An evaluation of a teacher education program in health and physical education. L. C. Schwich. XXII, 145

CONDENSATION PRODUCTS (CHEMISTRY)

Condensation reactions of fluorinated compounds. S. Resconich. XXII, 77

CONDUCTION OF HEAT see Heat—Conduction

CONIFERAE

Growth and development of four northern conifers under long and natural photoperiods in Wisconsin and Florida. R. F. Watt. XXII, 12

CONRAD, JOSEPH, 1857-1924. NOSTROMO

Master and man: a study of Conrad's Nostromo. R. L. Cox. XXII, 255

CONSOLIDATION OF SCHOOLS see Schools—Centralization

CONTINUOUS FUNCTIONS see Functions, Continuous

CONTRACEPTION see Birth control

CONTROL ENGINEERING see Automatic control

CONTROLLERS, ELECTRIC see Electric controllers

CONURBATIONS see Metropolitan areas

CONVECTION OF HEAT see Heat—Convection

COOPERATIVE CREDIT ASSOCIATIONS, AGRICULTURAL see Agricultural cooperative credit associations

COORDINATION COMPOUNDS

Coordination chemistry of piperazine and piperazine derivatives. F. W. Obear. XXII, 61

Coordination compounds of nickel (II). D. G. Karipides. XXII, 59

Dimethylsulfoxide as a solvent in coordination chemistry. D. K. Straub. XXII, 61

Heats of formation of coordination compounds. H. Kido. XXII, 94

Some coordination polymers prepared from bis-(β-diketones). J. S. Oh. XXII, 61

COPPER-ALUMINUM ALLOYS see Aluminum-copper alloys

COPPER CHELATES

A study of the polarography and visible spectra of a series of copper chelates of 1, 3-diketones. H. D. Russell. XXII, 46

COPPER PLATING

Mechanism of bright electroplating: laminations and periodicity in the deposition of nickel and copper. N. Vanderkooi, Jr. XXII, 102

CORN, INDIAN see Maize

CORPUSCULAR THEORY OF MATTER see Electrons

CORTICOTROPHIC HORMONES see ACTH

COSTS, INDUSTRIAL

The employment of labor and the cost of capital in manufacturing industries as they are related to wage changes and technological progress. R. I. McKinnon. XXII, 120

COTTON

A study of the effect of temperature levels of germination environment on chemical and physical characteristics of cotton seedlings. M. N. Christiansen. XXII, 14

COTTON—DISEASE AND PEST RESISTANCE

Inheritance of resistance to Fusarium wilt in upland cotton. J. E. Jones. XXII, 34

COUNSELING

The effects of group counseling in a controlled workshop setting on attitude, manual dexterity and ability to perceive correct spatial relations. M. Waldman. XXII, 328

The effects of group counseling on interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics in a planned workshop experience. M. Reiser. XXII, 325

COUNTY FINANCE see Local finance

COUNTY SCHOOL SYSTEMS—PENNSYLVANIA

Changing functions of the county superintendency in Pennsylvania schools. L. W. Showers. XXII, 142

COW-PEAS

Inheritance of growth habit and flowering response of the southern pea, Vigna sinensis, Endl. J. D. Norton. XXII, 36

COWS

Genetic relationships between lactation milk and fat yields and increases in production with age. J. R. Schabinger. XXII, 10

Investigations associated with the transplantation of bovine ova. T. L. Avery. XXII, 302

COZZENS, JAMES GOULD, 1903-

James Gould Cozzens and the professional man in American fiction. W. G. Wiegand. XXII, 266

CREATIVE ABILITY

Some relationships between creative writing and creative drawing of sixth grade children. C. A. Jones. XXII, 158

CRISIS THEOLOGY see Dialectical theology

CRITICISM—U. S.

Comments on art and literature from the personal writings of a group of well traveled, early American writers and artists. A critical collation. J. J. Lawler. XXII, 262

CROP YIELDS

Techniques for characterizing Oregon soils for agricultural purposes in terms of physical and economic productivities. S. C. James. XXII, 112

CRYOGENICS see Low temperatures

CRYSTALLOGRAPHY

Phase equilibrium and crystal chemical relationships in rare earth systems. I. Warshaw. XXII, 279

CUBISM

Shamanism and champagne: a critical introduction to the vorticist theory of Wyndham Lewis. J. H. Edman. XXII, 258

CULTURAL EVOLUTION see Social change

CULTURE CONTACT see Acculturation

CULTURE OF TISSUES see Tissue culture

CUMENE

Autoxidation inhibition in cumene. P. L. Weinle. XXII, 83

CURVED SURFACES see Surfaces

CURVES

Behavior of curves and surfaces through fundamental elements of birational transformations. E. F. Myers. XXII, 271

An involution of period seventeen. J. W. Kenelly, Jr. XXII, 270

CURVES, QUARTIC

Stress distribution of a rotating limaçon. J. L. Tilley, Jr. XXII, 274

CURVES ON SURFACES

Generalizations of curvatures associated with a curve on a surface. J. D. Novak. XXII, 271

CUTIS see Skin

CYANIDES

The preparation and structure of group V tricyanides. K. Emerson. XXII, 91

CYANOMETHANE see Acetonitrile

CYCLONIUM see Promethium

CYSTS

The effect of chemically-defined media upon tissue cultures of skin, cystic disease and carcinomas from the human female breast. M. F. Orr. XXII, 24

CYTOGENETICS

The crossing behavior and cytogenetics of Mimulus guttatus Fischer in the Bonneville Basin. D. W. Lindsay. XXII, 41

CYTOTOXIN see Serum

D D T (INSECTICIDE)

DDT-dehydrochlorinase in the Mexican bean beetle, Epilachna varivestis (Mul.). A. S. Tombes. XXII, 56

DAIRYING—NEW YORK (STATE)

The needs of diary farmers in agricultural mechanics in selected dairy counties of New York. W. H. Annis. XXII, 121

DARZENS CONDENSATION

Aldehydes and bases in the Darzens condensation. C. G. Carlile. XXII, 67

DEAF

An examination of perceptual and cognitive rigidity in deaf adolescent boys. M. H. Wodin. XXII, 329

DEBENTURES see Bonds

DECISION-MAKING

An analysis of the application of utility theory to the development of two-stage testing models. J. H. Rosenbach. XXII, 165

Decision making in two-person two-choice zero-sum games under different incentive conditions. J. G. Robertson, Jr. XXII, 337

"What if everyone did that?". J. H. Sobel. XXII, 286

DECISION PROBLEMS see Statistical decision

DECLAMATION see Readers and speakers

DECLAMATION, MUSICAL see Musical accentuation

DEEP-SEA EXPLORATION see Marine fauna

DEFECTIVE SPEECH see Speech, Disorders of

DEFOLIATION

The response of alfalfa to defoliation by grazing animals as compared to clipping. D. M. Gossett. XXII, 15

DEHYDRATING AGENTS see Drying agents

DELUSIONAL INSANITY see Paranoia

DEMENTIA PRAECOX see Schizophrenia

DEMOCRATIC PARTY

The volume and stability of intraparty consensus in the House of Representatives during four recent Congresses. L. F. Anderson. XXII, 307

DENOMINATIONAL SCHOOLS see Church schools

DESCENT see Heredity

DESICCANTS see Drying agents

DETROIT—SOCIAL CONDITIONS

Religion and social mobility in industrial society. N. J. Weller. XXII, 354

DEUTERONS

Analysis of some deuteron-induced reactions in oxygen - 18. J. C. Armstrong. XXII, 290

An apparatus for measuring fast neutron polarization and a measurement of D(d, n)He^3 neutron polarization. M. S. Zucker. XXII, 296

Deuteron jumping in KD_2PO_4. V. H. Schmidt. XXII, 300

DEUTERONS—SCATTERING

Nuclear reaction studies at intermediate energies. (Parts I and II). D. K. McDaniels. XXII, 293

DIALECTICAL THEOLOGY

Objective and subjective in Karl Barth's doctrine of reconciliation. P. H. Gertmenian. XXII, 339

DIALECTS see Arabic language—Dialects

DIAZOMALONIC ACID

A kinetic study of the acid catalyzed hydrolysis of the di-potassium salt of diazomalonic acid. C. H. Geisler. XXII, 92

DIBORON TETRACHLORIDE

The thermal decomposition and hydrogenation of diboron tetrachloride and diboron tetrafluoride. J. B. Barr. XXII, 86

DIBORON TETRAFLUORIDE

The thermal decomposition and hydrogenation of diboron tetrachloride and diboron tetrafluoride. J. B. Barr. XXII, 86

DICHLORO-DIPHENYL-TRICHLOROETHANE see DDT (Insecticide)

DICHLOROPHENYL METHACRYLAMIDE see Dicryl

DICKENS, CHARLES, 1812-1870

Dickens and Thackeray: the reciprocal influences. E. E. Irwin. XXII, 247

DICKINSON, EMILY, 1830-1886

Portrait of Emily Dickinson: the poet and her prose. D. J. M. Higgins. XXII, 246

DICRYL

A study of some physiological processes of corn as affected by N-(3, 4-dichlorophenyl) methacrylamide. H. H. Funderburk, Jr. XXII, 40

DIDACTICS see Teaching

DIELECTRICS

Dielectric relaxation at high frequencies. W. E. Vaughan. XXII, 102

Dielectric relaxation times and structures of some nonrigid molecules. W. P. Purcell. XXII, 100

DIELS-ALDER REACTION

Stereochemistry of the Diels-Alder reaction. J. G. Martin. XXII, 74

DIENAMINES

Part I: Synthetic approaches to tetracyclines. Part II: Mechanism of the reaction of carbonyl cyanide with olefins. Part III: Alkylation of dienamines. G. I. Birnbaum. XXII, 65

DIET

Effects of dietary sodium levels upon maternal responses of pyridoxine- and deoxypyridoxine-fed pregnant rats. A. Kirksey. XXII, 243

DIETHYLENEDIAMINE see Piperazine

DIFFERENTIAL EQUATIONS—NUMERICAL SOLUTIONS

Study of three-dimensional supersonic flow problems by a numerical method based on the method of characteristics (specially adapted for use on high speed electronic digital computers). C. C. Tsung. XXII, 187

DIFFUSION

The unsteady state diffusion of gases from anthracite at high temperatures. E. T. Nelson. XXII, 199

DIGESTION

Correlations between certain criteria of ruminant digestion in vivo and in vitro. D. M. Bowden. XXII, 1

Re-entrant duodenal fistula techniques: application to the study of digestion and passage in the bovine alimentary tract. A. D. McGilliard. XXII, 304

DIGITAL COMPUTERS, ELECTRONIC see Electronic digital computers

DIMETHYL see Ethanes

DIMETHYLSULPHOXIDES

Dimethylsulfoxide as a solvent in coordination chemistry. D. R. Straub. XXII, 61

DIOCESAN SCHOOLS see Church schools

DIOLEFINES

I. Polymerization of some cyclic, non-conjugated diolefins. II. An attempted synthesis of an ethylene-anthracene copolymer. R. Z. Greenley. XXII, 71

DIPHENYL

Studies directed toward a determination of the absolute configuration of an optically active diphenyl: the synthesis of 5-acetamino-1, 2, 3, 4-tetrahydronaphthalene-2-*β*-propanoic acid. A. J. Rich. XXII, 77

DIPHOSPHINE DIOXIDES

The synthesis of polymethylene-bridged diphosphine dioxides. R. F. Struck. XXII, 82

DIRECT TAXATION see Income tax; Taxation

DISCIPLINE, SCHOOL see School discipline

DISCOVERIES (IN SCIENCE) see Science

DISKS, ROTATING

Stress distribution of a rotating limaçon. J. L. Tilley, Jr. XXII, 274

DISORDERS OF SPEECH see Speech, Disorders of

DISSOCIATION

Cross section for dissociative recombination of nitric oxide. B. E. Squires, Jr. XXII, 294

DISTANCE GEOMETRY

Metrization and uniform continuity. S. C. Hanna. XXII, 269

DISTILLATION

A study of some transient conditions in continuous binary distillation operations. F. P. May, III. XXII, 198

DISTRIBUTION (PROBABILITY THEORY)

A decision procedure for the inclusion of an independent variable in a linear estimator. J. T. Webster. XXII, 275

DOCTORS see Physicians

DREISER, THEODORE, 1871-1945

The mind of Theodore Dreiser: a study in development. J. Davis. XXII, 255

DRESS see Clothing and dress

DRIVING, AUTOMOBILE see Automobile drivers

DROSOPHILA MELANOGASTER

Alternative methods of selection applied to plateaued populations of Drosophila melanogaster. W. P. Brown. XXII, 33

DROUGHTS

A situational analysis of the effects of drouth as a disaster on the mobility of a selected rural-farm population. C. W. Ketch. XXII, 352

DRUG TOXICITY see Drugs—Toxicology

DRUG TRADE—U. S.

The role of the detail man in the diffusion and adoption of an ethical pharmaceutical innovation within a single medical community. R. R. Rehder. XXII, 118

DRUGS

Syntheses and characterization of some 3, 4, 5-trimethoxybenzoyl; 3, 4, 5-trimethoxybenzyl; and 3, 4, 5-trimethoxyphenylethyl derivatives of piperazine and some related compounds. B. Silverman. XXII, 80

DRUGS—TOXICOLOGY

Cytotoxicity of antibacterial agents. M. H. Ruether. XXII, 284

DRYING AGENTS

An investigation of the hot surface drying of glass fiber beds. W. F. Cowan. XXII, 193

DUCHAMP, MARCEL, 1887-

The position of La mariée mise à nu par ses célibataires, même (1915-1923) in the stylistic and iconographic development of the art of Marcel Duchamp. L. D. Steefel, Jr. XXII, 220

DUMB (DEAF-MUTES) see Deaf

DURUM WHEAT see Wheat

DUTIES see Taxation

DYNAMICS OF A PARTICLE

On the motions of particles in Euclidean and non-Euclidean spaces under certain conservative force fields. R. L. Van de Wetering. XXII, 275

EARTH—CHEMICAL COMPOSITION see Geochemistry

EARTHS, RARE

Phase equilibrium and crystal chemical relationships in rare earth systems. I. Warshaw. XXII, 279

ECCLESIASTICAL ANTIQUITIES see Christian antiquities

ECCLESIASTICAL HISTORY see Church history

ECCLESIASTICAL THEOLOGY see Church

EDUCATION—PHILOSOPHY

A study in religious philosophy of higher education with special reference to the theistic naturalism of Bernard Eugene Meland and to the Biblical perspective. C. W. Whitworth. XXII, 344

EDUCATION—MINNESOTA—FINANCE

A comparative analysis of selected generalized formulas for the distribution of state aid for school plants in Minnesota. R. W. Marker. XXII, 141

EDUCATION—PENNSYLVANIA—MILTON

A historical study of education in Milton, Pennsylvania. J. E. Williams. XXII, 144

EDUCATION, ART see Art—Study and teaching

EDUCATION, ETHICAL see Religious education

EDUCATION, HIGHER

A study in religious philosophy of higher education with special reference to the theistic naturalism of Bernard Eugene Meland and to the Biblical perspective. C. W. Whitworth. XXII, 344

EDUCATION, PHYSICAL see Physical education and training

EDUCATION, PRIMARY

A team approach to theory and practice in early childhood teacher education. M. R. Sabath. XXII, 174

EDUCATION, RELIGIOUS see Religious education

EDUCATION, SCIENTIFIC see Science—Study and teaching

EDUCATION, THEOLOGICAL see Religious education

EDUCATION, VOCATIONAL see Vocational education

EDUCATION AND SOCIOLOGY see Educational sociology

EDUCATION OF ADULTS

A comparative study of some interests and attitudes relative to public school adult education. G. B. Wasinger. XXII, 143

EDUCATIONAL ADMINISTRATION see School management and organization

EDUCATIONAL LAW AND LEGISLATION—U. S.

An analysis of appellate court decisions determining the authority of boards of education and their agents to establish rules and regulations governing the conduct of pupils, 1900 to 1960. N. L. Gamberoni. XXII, 136

EDUCATIONAL SOCIOLOGY

Educational sociology — a status study. R. G. Hoyme. XXII, 182

EGG TRADE—SHREVEPORT, LA.

Effects of packaging on retail egg sales and on quality deterioration. R. P. Bentz. XXII, 109

EGGS

A study of certain physical and chemical properties of chicken eggs in relation to their initial albumen quality and to some characteristics of the hens which laid them. J. H. Skala. XXII, 221

EGGS—PACKING

Effects of packaging on retail egg sales and on quality deterioration. R. P. Bentz. XXII, 109

ELASTIC PLATES AND SHELLS

Torsional stiffness of non-uniformly heated cantilever plates for any aspect ratio and initial twist. D. W. Breuer. XXII, 187

ELASTICITY

Dynamics of an elastic-Bingham body. W. P. Acheson. XXII, 267

Stability of elastic and partially plastic frames. L.-W. Lu. XXII, 206

ELECTIONS—ITALY

The influence of socio-economic factors on party vote in the Italian general election of June 7, 1953. S. A. Watts, Jr. XXII, 311

ELECTRIC CONTROLLERS

On "Bang-Bang" adaptive control systems. R. E. Kopp. XXII, 210

ELECTRIC DISCHARGES THROUGH GASES

A study of the time lag of gas breakdown in reversed electric fields. H. W. Kendall. XXII, 289

ELECTRIC FILTERS

Dual-mode filtering. L. G. Shaw. XXII, 213

The eigenvalues for certain cylindrical structures. D. M. Bolle. XXII, 208

ELECTRIC NETWORKS

Numerical methods of approximation with application to electrical network design. R. R. Kenyon. XXII, 209

ELECTRIC PROPERTIES OF MATERIALS see subdivision Electric properties under names of materials or substances, e. g. Germanium —Electric properties; Lime—Electric properties; Zinc—Electric properties

ELECTRIC RESONATORS

D. C. effects in ferromagnetic resonance of thin nickel films. W. G. Egan. XXII, 298

ELECTRIC WAVE FILTERS see Electric filters

ELECTRICITY—DISCHARGES THROUGH GASES see Electric discharges through gases

ELECTRODEPOSITION OF METALS see Electroplating

ELECTROLYTES

Inorganic electrolytes in anhydrous acetonitrile. A. E. Marcinkowsky. XXII, 97

ELECTROMAGNETIC THEORY

Electromagnetic radiation due to vibrating systems of charges and currents. C. M. Evans. XXII, 209

ELECTRONIC DIGITAL COMPUTERS

Proposal, development, and testing of a system of analytical triangulation for medium-scale digital computers. W. C. Mahoney. XXII, 230

ELECTRONS

Formation of negative ions in CO by charge transfer. F. Hushfar. XXII, 288

ELECTROPLATING

Mechanism of bright electroplating: laminations and periodicity in the deposition of nickel and copper. N. Vanderkooi, Jr. XXII, 102

ELEMENTARY PARTICLES (PHYSICS) see Particles (Nuclear physics)

EMPATHY

Supervisor perception of subordinate attitudes. T. H. Jerdee. XXII, 334

EMPLOYEE BENEFITS see Non-wage payments

EMPLOYEE-EMPLOYER RELATIONS see Industrial relations

EMPLOYEES, CLERICAL see Clerks

EMPLOYEES, SUPERVISION OF see Supervision of employees

EMPLOYEES' REPRESENTATION IN MANAGEMENT—GERMANY (FEDERAL REPUBLIC, 1949-)

Codetermination and the West German trade unions. G. R. Crossman. XXII, 308

ENCEPHALITIS see Brain—Inflammation

ENDOTOXIN SHOCK

Studies on the carotid sinus baroceptors with particular reference to endotoxin shock. J. W. Trank. XXII, 306

ENGINEERING, AGRICULTURAL see Agricultural engineering

ENGINEERING, ARCHITECTURAL see Strains and stresses; Structures, Theory of

ENGINEERING, CHEMICAL see Chemical engineering

ENGINEERING, STRUCTURAL see Strains and stresses; Structures, Theory of

ENGINEERING, WATER-SUPPLY see Water-supply engineering

ENGINEERING AS A PROFESSION

A study of the effectiveness of the Kuder preference record-vocational in discriminating among Purdue engineering graduates. D. M. McMillen. XXII, 162

ENGLAND, CHURCH OF see Church of England

ENGLISH LANGUAGE—READERS AND SPEAKERS see Readers and speakers

ENGLISH LANGUAGE—RHETORIC

The construction and validation of a test of certain factors in writing ability at the college freshman level. H. J. Kenney. XXII, 159

ENGLISH LANGUAGE—OLD ENGLISH see Anglo-Saxon language

ENZYME ANTAGONISTS see Antimetabolites

ENZYMES

A comparative study of some endocellular proteolytic enzymes of an oxidative type yeast. R. L. Maginnis. XXII, 31

A study of the glycolytic enzymes in the aquatic snail Physa halei Lea. C. G. Beames, Jr. XXII, 364

EPIGRAPHY see Inscriptions

EPINEPHRIN see Adrenalin

EPISCOPAL CHURCH see Church of England

EQUATIONS, DIFFERENTIAL see Differential equations

EQUILIBRIUM, CHEMICAL see Chemical equilibrium

EQUILIBRIUM, THERMAL see Heat; Thermodynamics

ERLANG TRAFFIC FORMULA see Queuing theory

ERUPTIVE ROCKS see Rocks, Igneous

ESTRUS

The influence of ambient temperature on early pregnancy loss as determined by embryo transfer. C. W. Alliston. XXII, 301

Investigations associated with the transplantation of bovine ova. T. L. Avery. XXII, 302

ETHANES

The radiation induced exchange of carbon between ethane and methyl amine. P. S. Lamprey. XXII, 95

ETHENE SERIES see Olefines

ETHICAL EDUCATION see Religious education

ETHYLENE SERIES see Olefines

ETHYLENEIMINE see Piperazine

ETTINGSHAUSEN-NERNST EFFECT

Effect of pressure on the Ettingshausen-Nernst effect in Zinc at helium temperatures. R. J. Deck. XXII, 297

EVALUATION OF LITERATURE see Criticism

EVIDENCE

Foundations of acceptance. G. F. Rieman, Jr. XXII, 286

EXCHANGE ADSORPTION see Ion exchange

EXCITON

Exciton theory: application to H-bonded complexes. M. A. El-Bayoumi. XXII, 90

EXCRETION

The effects of neurohypophysial hormones on electrolyte excretion and renal hemodynamics in dogs. W.-Y. Chan. XXII, 283

EXPERIENCE (RELIGION)

Religious experience in the theological method of Schleiermacher, Herrmann, and Bultmann. T. Sato. XXII, 344

EXPERIMENTAL PSYCHOLOGY see Psychology, Physiological

EXPLORATION OF THE DEEP SEA see Marine fauna

EXTRACTION (CHEMISTRY)

Individual mass transfer resistances in liquid-liquid extraction. S. H. Hong. XXII, 196

Individual phase behavior in liquid-liquid extraction. F. L. Poska. XXII, 200

FACULTY (EDUCATION) see Teachers

FAMILY

A study of role consensus in the family system. A. Yourglich. XXII, 355

FAMILY IN LITERATURE

Content analysis of middle class women's fiction from 1901 to 1960 as indicative of changing cultural values related to middle class birth-rates. E. V. Smith. XXII, 354

FAMILY LIFE EDUCATION

Family life education in the public high schools of Pennsylvania, 1957-58. A. A. Glatthorn. XXII, 181

FARM CROPS see Field crops

FARM INCOME—INDIA

Increasing income and production in Indian farming: possibilities with the existing resource supplies on individual farms. D. K. Desai. XXII, 111

FARM MECHANICS see Agricultural engineering

FARMERS

A situational analysis of the effects of drouth as a disaster on the mobility of a selected rural-farm population. C. W. Ketch. XXII, 352

FARMERS' COOPERATIVES see Agricultural cooperative credit associations

FARMING see Agriculture

FARMS, SIZE OF—NORTH CAROLINA

An economic appraisal of farming adjustment opportunities to meet changing conditions in Economic Area 7, North Carolina. R. L. Rizek. XXII, 113

FATIGUE OF METALS see Metals—Fatigue

FAUNA see Marine fauna

FAVORED NATION CLAUSE

Equality of treatment and trade discrimination in international law: a study. K. Hasan. XXII, 313

FEAR

The effects of epinephrine, chlorpromazine, and dibenzyline upon the fright responses of rats under stress and non-stress conditions. J. E. Singer. XXII, 318

FEE SYSTEM (TAXATION) see Taxation

FEEDBACK CONTROL SYSTEMS

Optimization in a mean-square-error sense of a two-dimensional sampled-data system. C. H. Murrish. XXII, 210

Stability analysis of nonlinear control systems by the second method of Liapunov. Z. V. Rekasius. XXII, 212

FEELING see Perception

FELDSPAR

Causes of optical scatter in plagioclase feldspar. R. C. Doman. XXII, 278

FEMALE see Woman

FEMALE SEX HORMONES see Hormones, Sex

FEMINISM see Woman

FERMENTS see Enzymes

FERRIC CHLORIDE

Reactions of ferric chloride with aromatic compounds. C. Wu. XXII, 84

FESTUCA ARUNDINACEA see Tall fescue

FIBER GLASS see Glass fibers

FIELD CROPS

The influence of different cropping schemes on the amino acid content, total nitrogen, and total organic carbon content of soil. U. C. Gupta. XXII, 3

FILMS, METALLIC see Metallic films

FINANCE, LOCAL see Local finance

FINANCE, PUBLIC—BEVERLY HILLS, CALIF.

Financial reporting as a means of communication in a public jurisdiction. A. Nabavi. XXII, 315

FINE ARTS see Art; Music

FISCAL POLICY see Finance, Public

FISHES--PENNSYLVANIA—CLARION RIVER

The composition of fish communities in relation to river pollution. D. G. Bardarik. XXII, 364

FISHES—PENNSYLVANIA—TIONESTA CREEK

The composition of fish communities in relation to river pollution. D. G. Bardarik. XXII, 364

FLAVOR

Factors associated with the flavor of poultry meat. J. V. Spencer. XXII, 222

FLETCHER, JOHN GOULD, 1886-1950

The oriental influence in John Gould Fletcher's poetry. E. B. Stephens. XXII, 264

FLORA see Botany

FLOW OF WATER see Hydraulics

FLUID DYNAMICS

Effects of pulsed flow in fixed ion-exchange beds. M. Warren. XXII, 202

Heat and momentum transfer in the incompressible boundary layer on a flat plate. O. T. Hanna. XXII, 195

A study of fluid flow and mass transfer in trickle-bed reactors. W. E. Schiesser. XXII, 201

A study of pulsatile flow phenomenon. R. G. Linford. XXII, 198

A study of the structure of turbulent shear flow in pipes. W. A. Brookshire. XXII, 192

FLUORINE COMPOUNDS

Condensation reactions of fluorinated compounds. S. Resconich. XXII, 77

Studies of certain fluorine-containing alkyl bromides. R. D. Battershell. XXII, 64

FLUOROCARBONS

Fluorocarbon polyphosphine chemistry. L. R. Grant, Jr. XXII, 59

FLUOROMETALLATES

Preparation and structural properties of some fluorometallates of uranium and group V metals. A. E. Baker. XXII, 58

FOLIAGE see Leaves

FOOD—PACKAGING

Consumers' preferences for selected types of food packaging. T. M. Brooks. XXII, 109

FOOD HABITS

Some environmental influences on food habits of women clerical workers. A. J. Bricker. XXII, 242

FORAGE PLANTS

A study of the root and top growth of several forage species as influenced by nitrogen and irrigation treatments. W. H. Mitchell. XXII, 17

FORAGE PLANTS—IRRIGATION

A study of the root and top growth of several forage species as influenced by nitrogen and irrigation treatments. W. H. Mitchell. XXII, 17

FOREIGN NEWS

Meaning intensity as related to readership of foreign news. J. T. McNelly. XXII, 347

FOREST ECOLOGY

The relation of soil and other site factors to forest composition and productivity in west Tennessee. E. A. Hebb. XXII, 10

FOREST PLANTING see Forests and forestry

FOREST SOILS

Hydrologic balance of three soils supporting natural hardwoods, planted red pine, and old field plant communities in central Pennsylvania. W. R. Byrnes. XXII, 13

The relation of soil and other site factors to forest composition and productivity in west Tennessee. E. A. Hebb. XXII, 10

FORESTS AND FORESTRY—TENNESSEE

The relation of soil and other site factors to forest composition and productivity in west Tennessee. E. A. Hebb. XXII, 10

FORMALDEHYDE

Electron exchange polymers from disubstituted hydroquinones and formaldehyde. R. K. Quisenberry. XXII, 76

FORMALIN see Formaldehyde

FOWLS see Poultry

FRAMEWORKS (STRUCTURES) see Structural frames

FRANCE—FOREIGN RELATIONS—RUSSIA

French policy in Russia: 1755-1762. L. J. Oliva. XXII, 240

FRANCHISE see Elections

FREE SCHOOLS see Public schools

FREEZING see Temperature—Physiological effect

FRENCH CLOVER see Alfalfa

FRENCH LANGUAGE—STUDY AND TEACHING —AUDIO-VISUAL AIDS

Audio-visual second-language learning: a historical review and comparative evaluation of the use of audio-visual instructional materials and teaching techniques in first-year high school French. N. M. Dostal. XXII, 179

FRENCH LANGUAGE—STUDY AND TEACHING (ELEMENTARY)

An experiment to determine the effect of learning conversational French on academic achievement of third grade children: an investigation to determine whether instruction in conversational French in third grade classes in suburban and metropolitan New York schools will affect achievement in reading, arithmetic, spelling, and language. E. W. Lopato. XXII, 160

FREQUENCY CURVES

Item characteristics and skewness of observed score distributions. J. D. Hundleby. XXII, 333

FREQUENCY DISTRIBUTION see Distribution (Probability theory)

FRIENDSHIP

Friendship formation in two adjacent interracial housing projects. D. S. Claster. XXII, 346

FRIESIAN CATTLE see Holstein-Friesian cattle

FRINGE BENEFITS see Non-wage payments

FROGS

A comparative study of embryonic and adult frog actomyosin. M. M. K. Nass. XXII, 368

FUNCTIONS, CONTINUOUS

Higher degrees of distributivity in lattices of continuous functions. E. C. Weinberg. XXII, 276

Metrization and uniform continuity. S. C. Hanna. XXII, 269

On the product of real valued uniformly continuous functions in metric spaces. N. J. Saber. XXII, 272

FUSARIUM OXYSPORUM

Some physiological comparisons of the fusarium surface rot and fusarium wilt pathogens of sweet potato. K. D. Fisher. XXII, 21

FUSARIUM VASINFECTUM

Inheritance of resistance to Fusarium wilt in upland cotton. J. E. Jones. XXII, 34

G A T T see General agreement on tariffs and trade

GALLIUM MONOHYDRIDE

Part I. The visible spectrum of the gallium monohydride molecule. Part II. An evaluation of the coriolis interaction in asymmetric top molecules. M. L. Ginter. XXII, 93

GALVANOPLASTY see Electroplating

GAME THEORY

Decision making in two-person two-choice zero-sum games under different incentive conditions. J. G. Robertson, Jr. XXII, 337

GAMMA RAYS

Directional correlation of successive gamma rays in Ba^{136} and Mo^{94}. H. Bernstein. XXII, 290

GAMMA RAYS—PHYSIOLOGICAL EFFECT

The effects of cobalt 60 gamma radiation on microsporogenesis and male gametophyte development in tomato (Lycopersicon esculentum Mill.). M. Singh. XXII, 38

GASEOUS DISCHARGE see Plasma (Ionized gases)

GASES—ABSORPTION AND ADSORPTION

Effects of sonic vibrations on the rate of absorption of gases from bubble beds. K. L. Harbaum. XXII, 196

GASES—DIFFUSION see Diffusion

GASES, ELECTRIC DISCHARGES THROUGH see Electric discharges through gases

GASIFICATION OF CARBON see Carbon gasification

GELS

Particle-particle interaction in organic media. J. P. Wightman. XXII, 83

GENERAL AGREEMENT ON TARIFFS AND TRADE

Equality of treatment and trade discrimination in international law: a study. K. Hasan. XXII, 313

GENERALIZATION

The generalization of verbal conditioning. A. M. L. Rosenberg. XXII, 326

GENERATION see Reproduction

GENES see Heredity

GEOCHEMISTRY

Isotopic geochemistry of sulphur. W. U. Ault. XXII, 227

GEOGNOSY see Geology

GEOGRAPHICAL NAMES see Names, Geographical

GEOLOGICAL CHEMISTRY see Geochemistry

GEOLOGY—STUDY AND TEACHING

Geology for Florida junior colleges. M. L. Ivey. XXII, 183

GEOLOGY—COLORADO

Structural development of the Williams Range thrust, Colorado. J. H. Howard. XXII, 229

GEOLOGY—DOMINICAN REPUBLIC

Geology of central Dominican Republic. C. O. Bowin. XXII, 228

GEOLOGY—NEW MEXICO—HIDALGO COUNTY

Geology of Walnut Wells quadrangle, Hidalgo County, New Mexico. A. M. Alper. XXII, 227

GEOLOGY—ONTARIO—SUDBURY DISTRICT

The geology of Levack Township. F. F. Langford. XXII, 229

GEOLOGY—PENNSYLVANIA

Lithostratigraphy of the Middle Ordovician Salona and Coburn formations of the Trenton group in central Pennsylvania. R. R. Thompson. XXII, 231

GEOLOGY—SOUTH DAKOTA

Stratigraphy of the Ogallala group of a portion of southwestern South Dakota. W. D. Sevon III. XXII, 231

GEOLOGY, CHEMICAL see Geochemistry

GEOLOGY, STRATIGRAPHIC—LOWER SILURIAN see Geology, Stratigraphic—Ordovician

GEOLOGY, STRATIGRAPHIC—NEOCENE

Stratigraphy of the Ogallala group of a portion of southwestern South Dakota. W. D. Sevon III. XXII, 231

GEOLOGY, STRATIGRAPHIC—ORDOVICIAN

Lithostratigraphy of the Middle Ordovician Salona and Coburn formations of the Trenton group in central Pennsylvania. R. R. Thompson. XXII, 231

GEOLOGY, STRATIGRAPHIC—TERTIARY

Glauconite in early Tertiary sediments of the Gulf Coastal Province. E. G. Wermund, Jr. XXII, 232

GEOLOGY, STRUCTURAL

Structural development of the Williams Range thrust, Colorado. J. H. Howard. XXII, 229

GEOMORPHOLOGY see Geology, Structural

GERMAN FICTION—20th CENTURY—HISTORY AND CRITICISM

Antinationalsozialistische Gestalten im deutschen Nachkriegsroman. [German text] J. Kempers. XXII, 261

GERMAN LANGUAGE—STUDY AND TEACHING

Prediction of student academic achievement in beginning German at Purdue University. W. M. Hill. XXII, 154

GERMAN REFORMED CHURCH (U. S.) see Reformed Church in the United States

GERMANIUM—ELECTRIC PROPERTIES

Galvanomagnetic properties of carriers associated with the cleaned germanium surface. R. A. Missman, Jr. XXII, 299

GERMANIUM-TIN-TELLURIUM ALLOYS

The structural and transport properties of the pseudo-binary alloy GeTe-SnTe. J. N. Bierly, Jr. XXII, 296

GERMINATION

I. The partial purification and properties of a germination inhibitor(s) isolated from apple seed. II. Pyrimidine metabolism in germinating seedlings. W. R. Evans. XXII, 49

GERMS see Bacteriology

GESTATION see Pregnancy

GIRDERS

Inelastic lateral instability of beams and their bracing requirements. G. C. Lee. XXII, 206

Vibration analysis of continuous beam-columns with uniformly distributed axial load. E. H. McKinney. XXII, 270

GLASGOW, ELLEN ANDERSON GHOLSON, 1874-1945

A study of values in selected published prose of Ellen Glasgow. H. W. Edwards. XXII, 258

GLASS FIBERS

An investigation of the hot surface drying of glass fiber beds. W. F. Cowan. XXII, 193

GLASS MANUFACTURE—U. S.

An economic study of the United States glass industry, 1899-1947. S. Jeckovich. XXII, 118

GLASS TRADE—U. S.

An economic study of the United States glass industry, 1899-1947. S. Jeckovich. XXII, 118

GLAUCONITE

Glauconite in early Tertiary sediments of the Gulf Coastal Province. E. G. Wermund, Jr. XXII, 232

GLUCINIUM see Beryllium

GLUCOKINASE

Glucose utilization by rat liver. D. L. Di Pietro. XXII, 48

GLUCOSE

Glucose utilization by rat liver. D. L. Di Pietro. XXII, 48

GLUCOSE METABOLISM

The catabolism of gluconate in Escherichia coli. D. E. Jones. XXII, 52

GLUCOSE SULPHATE

The preparation and properties of glucose-6-sulfate. K. B. Guiseley. XXII, 71

GLUCOSIDES

The influence of alpha methyl glucoside on invertase action. B. Freeman. XXII, 50

GLYCOPEPTIDES

Preparation and chemical studies of glycopeptides derived from ovalbumin. R. H. Nuenke. XXII, 54

GONADOTROPIN

The influence of hypothyroidism and chorionic gonadotrophin on ovarian and adrenal ascorbic acid in the rat. R. P. Blye. XXII, 364

GONZÁLEZ DEL CASTILLO, JUAN IGNACIO, 1763-1800

Tradition and originality in the dramatic works of Juan Ignacio González del Castillo. D. G. Hannan. XXII, 260

GORKY, ARSHILE, 1904-1948

A stylistic analysis of Arshile Gorky's art from 1943-1948. R. F. Reiff. XXII, 219

GOVERNMENT REGULATION OF COMMERCE see Commercial policy

GRADED SCHOOLS see Ability grouping in education

GRAMMAR SCHOOLS see Public schools

GRASSES

The effect of phosphorus and potassium on the botanical and chemical composition, yield, and persistence of alfalfa and certain grasses grown in combination. J. N. Pratt. XXII, 18

GRAVEL

A study of chert and shale gravel in concrete. R. L. Schuster. XXII, 207

GREAT BRITAIN--HISTORY--HENRY III, 1216-1272

John Maunsell, the king's clerk, 1230-1265. J. O. Baylen. XXII, 32

GREECE—HISTORY—HISTORIOGRAPHY

Salamis and Plataea in the tradition of the Attic orators. F. W. Schlatter, S. J. XXII, 252

GREEK ORATORS see Orators, Greek

GRIGNARD REAGENTS

Reactions of certain Grignard reagents of sulfones and disulfones. E. T. Boyd. XXII, 67

GRINDING AND POLISHING

A phenomenological approach to the batch grinding of coals. R. P. Gardner. XXII, 194

GROSS NATIONAL PRODUCT—U. S.

Wage and non-wage shares in business product, 1899-1929. A. I. Grant. XXII, 107

GROUPING, HOMOGENEOUS see Ability grouping in education

GROUPS, THEORY OF

Some results on the anticenter of a group. G. C. Smith. XXII, 273

GROWTH (PLANTS)

Factors affecting uptake and movement of certain substances in the strawberry plant. R. Garren, Jr. XXII, 15

Growth and development of four northern conifers under long and natural photoperiods in Wisconsin and Florida. R. F. Watt. XXII, 12

Morphological and developmental changes in the bean Phaseolus vulgaris L. as modified by the application of various growth regulators. J. S Vandemark. XXII, 19

Physical impedance as a factor limiting plant growth and root penetration into compact subsoils. F. Y. Borden. XXII, 13

A study of the root and top growth of several forage species as influenced by nitrogen and irrigation treatments. W. H. Mitchell. XXII, 17

Sudangrass and pearl millet development and productivity as influenced by cutting heights. D. A. Mays. XXII, 17

GROWTH INHIBITING SUBSTANCES

I. The partial purification and properties of a germination inhibitor(s) isolated from apple seed. II. Pyrimidine metabolism in germinating seedlings. W. R. Evans. XXII, 49

A study of the effect of growth substances on fruit-setting of the mango. T. T. Sturrock. XXII, 19

GROWTH PROMOTING SUBSTANCES

A study of the effect of growth substances on fruit-setting of the mango. T. T. Sturrock. XXII, 19

A study on the effects of streptomycin on mammalian cells in culture and a study on the separation of growth promoting material for cell cultures from horse serum by dialysis. D. P. Metzgar, Jr. XXII, 36

GUILLAUME, LE CLERC, 13th cent. FERGUS

A study on the Old French romance of Fergus. W. L. Frescoln. XXII, 259

GUINEA-PIGS

Influence of dietary protein on liver constituents of tuberculous and non-tuberculous guinea pigs. R. E. Bleiler. XXII, 242

Requirement of avian C'1 for fixation of guinea pig complement by avian antibody-antigen complexes. H. N. Benson. XXII, 7

GUMS AND RESINS

Part one: Sorption of phenol by low-capacity ion-exchange resins. Part two: An analytical and kinetic study of a chelating resin. R. S. Turse. XXII, 46

HADLEY, HENRY KIMBALL, 1871-1937

Henry Kimball Hadley: his life and works (1871-1937). J. C. Canfield, Jr. XXII, 280

HANDICAPPED CHILDREN

The evaluation of teacher consultation compared with casework and community services as reflected by certain areas of growth and learnin elementary school children. F. K. Katz. XXII, 159

HANDICAPPED CHILDREN—EDUCATION

A study of the development of the special education program in Kansas, and an evaluation, with emphasis on the professional preparation of special education personnel. J. J. Eisenbach. XXII, 122

HARDWOOD SMOKE

The chemical composition of hardwood smoke. V. J. Jahnsen. XXII, 51

HEARING—TESTING see Audiometry

HEART

Respiration and phosphorylation in heart and liver mitochondria isolated from altitude acclimatized rats. E. H. Strickland, Jr. XXII, 56

HEAT—CONDUCTION

Extensions and applications of the method of finite transforms. S. Kaplan. XXII, 214

HEAT—CONVECTION

Combined free and forced convection from rotating bodies of revolution. R. G. Hering. XXII, 213

HEAT—TRANSMISSION

Heat and momentum transfer in the incompressible boundary layer on a flat plate. O. T. Hanna. XXII, 195

Heat transfer to a mist flow. J. D. Parker. XXII, 214

A new correlation for direct contact heat transfer coefficients in baffle and perforated plate towers. D. A. Winkler. XXII, 203

Transport processes in two-phase turbulent flow. C. -L. Tien. XXII, 215

HEAT, SPECIFIC see Specific heat

HEAT BARRIER see Aerodynamic heating

HEAT IN ANIMALS see Estrus

HEATING, AERODYNAMIC see Aerodynamic heating

HEATING-PIPES

An investigation of boiling with single and parallel channel flow. J. D. Roarty. XXII, 215

HEAVY ELECTRONS see Mesons

HELMINTHOSPORIUM VICTORIAE

Comparative morphology and respiration of normal and diseased Helminthosporium victoriae. E. E. Psarros. XXII, 22

HENS see Poultry

HERBAGE see Grasses

HERBICIDES

The effects of herbicidal chemicals on the activity of terminal oxidase enzymes in plant tissues. K. L. Hill. XXII, 303

HEREDITY

Alternative methods of selection applied to plateaued populations of Drosophila melanogaster. W. P. Brown. XXII, 33

Character association analysis in alfalfa. A. Jones. XXII, 34

The crossing behavior and cytogenetics of Mimulus guttatus Fischer in the Bonneville Basin. D. W. Lindsay. XXII, 41

The effect of selection on genetic variances and covariances of some traits of the fowl. G. W. Friars. XXII, 8

Genetic relationships between lactation milk and fat yields and increases in production with age. J. R. Schabinger. XXII, 10

Inheritance of growth habit and flowering response of the southern pea, Vigna sinensis, Endl. J. D. Norton. XXII, 36

Inheritance of resistance to Fusarium wilt in upland cotton. J. E. Jones. XXII, 34

Quantitative genetics of height in brachytic, corn. W. Prensky. XXII, 37

HEXAPODA see Insects

HIGH-SPEED AERODYNAMICS see Aerodynamics, Supersonic

HIGHER EDUCATION see Education, Higher

HIGHWAY ACCIDENTS see Traffic accidents

HIGHWAY CONSTRUCTION WORKERS see Road construction workers

HIGHWAYS see Roads

HISTORICAL GEOLOGY see Geology, Stratigraphic

HISTORY—PHILOSOPHY

The development of R. G. Collingwood's theory of history. H. DeLong. XXII, 285

HISTORY, ECCLESIASTICAL see Church history

HISTRIONICS see Theater

HOGS see Swine

HOLSTEIN-FRIESIAN CATTLE

Genetic relationships between lactation milk and fat yields and increases in production with age. J. R. Schabinger. XXII, 10

HOME AND SCHOOL

Some factors in the efficacy of training mothers of slow learning and normal children with functional articulation problems. R. K. Sommers. XXII, 362

HOMICIDE

Criminal homicide (a study in culture conflict). C. H. S. Jayewardene. XXII, 351

Homogeneity of first degree homicide cases as revealed by institutional characteristics. C. M. Unkovic. XXII, 353

HOMOGENEOUS GROUPING see Ability grouping in education

HOPKINS, GERARD MANLEY, 1844-1889

Gerard Manley Hopkins and the critics. D. E. H. Parker. XXII, 263

HORMONES

The effect of altered endocrine states on the properties of hepatic glutamic-pyruvic transaminase. D. S. Beattie. XXII, 47

The effects of neurohypophysial hormones on electrolyte excretion and renal hemodynamics in dogs. W. -Y. Chan. XXII, 283

The synthesis of peptides related to α-melanocyte stimulating hormone and the corticotropins. S. Lande. XXII, 52

HORMONES, SEX

Effect of female sex hormones (estrogen and progesterone), thyroid gland (thyroxine) and vitamin B_{12} on the uterus. M. S. Fahim. XXII, 8

HULL, CORDELL, 1871-1955

The public life of Cordell Hull: 1907-1924. C. Milner. XXII, 239

HUMAN INTERACTION see Social interaction

HUMAN RELATIONS see Interpersonal relations

HUSBANDRY see Agriculture

HUSBANDS

A study of role consensus in the family system. A. Yourglich. XXII, 355

HYDRAULICS

A theoretical analysis of the decay of secondary flow following a pipe bend. C. C. Shih. XXII, 189

HYDROCARBONS

Synthesis of hydrocarbons from thiophene derivatives. I. J. Spilners. XXII, 81

HYDRODYNAMICS

Characteristics of flow in irrigation furrows. J. R. Davis. XXII, 188

HYDROGEN PHOSPHIDE see Phosphine

HYDROLYSIS

A kinetic study of the acid catalyzed hydrolysis of the di-potassium salt of diazomalonic acid. C. H. Geisler. XXII, 92

HYDROQUINONE

Electron exchange polymers from disubstituted hydroquinones and formaldehyde. R. K. Quisenberry. XXII, 76

HYDROXYTRYPTAMINE see Serotonin

ICONOGRAPHY see Art

IDEALS (ALGEBRA)

Certain ideals in algebras of extended real-valued functions. H. Banilower. XXII, 267

IDENTITY, PERSONAL see Personality

IGNEOUS ROCKS see Rocks, Igneous

ILLIAC (COMPUTER)

Study of three-dimensional supersonic flow problems by a numerical method based on the method of characteristics (specially adapted for use on high speed electronic digital computers). C. C. Tsung. XXII, 187

ILLINIUM see Promethium

ILLINOIS AUTOMATIC COMPUTER see Illiac (Computer)

INCOME ACCOUNTING

The determination of business income in times of rising prices. M. N. H. El-Hawary. XXII, 116

INCOME TAX—U. S.

The Internal revenue act of 1954: policy and politics. E. N. Feingold. XXII, 310

INDIAN CORN see Maize

INDIANA. BALL STATE TEACHERS COLLEGE, MUNCIE—STUDENTS

A study of nonintellectual factors related to academic achievement among college seniors at Ball State Teachers College. J. G. Hunt. XXII, 157

INDIANS OF NORTH AMERICA—MISSIONS

Protestant missionaries to the American Indians, 1787 to 1862. R. F. Berkhofer, Jr. XXII, 25

INDIANS OF NORTH AMERICA, CIVILIZATION OF

Protestant missionaries to the American Indians, 1787 to 1862. R. F. Berkhofer, Jr. XXII, 25

INDIRECT TAXATION see Taxation

INDOLACETIC ACID

An addition reaction of the plant growth hormone. T. H. Plummer, Jr. XXII, 18

INDUCTION (MAGNETISM) see Magnetic induction

INDUSTRIAL ADMINISTRATION see Industrial management

INDUSTRIAL CHEMISTRY see Chemical engineering

INDUSTRIAL COSTS see Costs, Industrial

INDUSTRIAL MANAGEMENT

An analysis of the long-range planning process in a select group of business firms. R. H. Bock. XXII, 115

INDUSTRIAL RELATIONS—MICHIGAN

Survey of industrial relations in leading Michigan road construction firms. G. J. Gore. XXII, 117

INDUSTRIAL UNIONS see Trade-unions

INDUSTRIES, LOCATION OF—CASE STUDIES

Industrial agglomeration theory and the agglomerative impact of basic steel mills — two case studies. B. B. Christopher. XXII, 106

INDUSTRIES, LOCATION OF—SIBERIA, WESTERN

Industrial development in Western Siberia, a geographical analysis. R. E. Lonsdale. XXII, 225

INDUSTRIES, LOCATION OF—U. S.

Planning for industrial development: with emphasis on the metropolitan area. C. J. Wingfield. XXII, 316

INFLATION (FINANCE)

A historical study of the effects of inflation on the market for bonds. R. T. Mullins. XXII, 120

INFORMATION THEORY

Dual-mode filtering. L. G. Shaw. XXII, 213

INFRA-RED SPECTRUM see Spectrum, Infra-red

INHERITANCE (BIOLOGY) see Heredity

INNOVATIONS, TECHNOLOGICAL see Technological innovations

INSANITY, DELUSIONAL see Paranoia

INSCRIPTIONS—CRETE

Early Christian inscriptions of Crete. A. C. Bandy. XXII, 251

INSECTS—PHYSIOLOGY

Low temperature tolerance of insects in relation to the influence of temperature on muscle apyrase activity. J. A. Mutchmor. XXII, 304

INSECURITY (PSYCHOLOGY) see Security (Psychology)

INSPECTION OF SCHOOLS see School management and organization

INSTITUTIONS, CHARITABLE AND PHILANTHROPIC see Charities

INSTRUCTION see Education; Teaching

INTEGRALS

Asymptotic methods of evaluating $\int_a^\infty f(x)dx$. W. Richardson. XXII, 272

INTELLECT

The effects of group counseling on interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics in a planned workshop experience. M. Reiser. XXII, 325

INTELLIGENCE LEVELS—TESTING see Mental tests

INTELLIGENCE OF ANIMALS see Psychology, Comparative

INTERACTION, SOCIAL see Social interaction

INTEREST (PSYCHOLOGY)

A factorial analysis of the "basic" interest patterns of two hundred women college students in various curricular groups. A. C. Montague. XXII, 324

Meaning intensity as related to readership of foreign news. J. T. McNelly. XXII, 347

The relationship between scores on the Strong vocational interest blank and academic performance at the State University of New York College of Medicine at Syracuse. S. E. Smith. XXII, 166

A study of the effectiveness of the Kuder preference record-vocational in discriminating among Purdue engineering graduates. D. M. McMillen. XXII, 162

INTERNAL FRICTION

Internal friction in aluminum oxide single crystals. R. J. Huber. XXII, 299

INTERNAL REVENUE CODE see U. S. Laws, statutes, etc. Internal revenue code

INTERNATIONAL INTELLECTUAL COOPERATION ORGANIZATION see League of Nations. Intellectual Co-operation Organization

INTERPERSONAL RELATIONS

The effects of group counseling on interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics in a planned workshop experience. M. Reiser. XXII, 325

INTERPRETIVE DANCING see Modern dance

INVERTASE

The influence of alpha methyl glucoside on invertase action. B. Freeman. XXII, 50

IODONIUM SALTS

Syntheses and reactions of iodonium salts. R. A. Falk. XXII, 70

ION EXCHANGE

Effects of pulsed flow in fixed ion-exchange beds. M. Warren. XXII, 202

Ion exchange in ternary systems. J. S. Dranoff. XXII, 193

IONIZATION

Formation of negative ions in CO by charge transfer. F. Hushfar. XXII, 288

IRON-NICKEL ALLOYS

Reversible and slow speed irreversible magnetization processes in 50 % nickel-iron alloys. L. L. Ogborn. XXII, 211

IRONY IN LITERATURE

Irony in the works of Henry Adams. H. B. Rule. XXII, 249

IRRADIATION

Bombardment of tungsten with 20 kev helium atoms in a field ion microscope. M. K. Sinha. XXII, 300

IRRIGATION, OVERHEAD see Sprinkler irrigation

IRRIGATION CANALS AND FLUMES

Characteristics of flow in irrigation furrows. J. R. Davis. XXII, 188

IRRIGATION RESEARCH

Characteristics of flow in irrigation furrows. J. R. Davis. XXII, 188

ISATIN

Utilization of alkyl isobutyl ketones in the Pfitzinger reaction. K. W. Bartz. XXII, 63

ISING MODEL

High density expansion for the Ising model with arbitrary spin and range of interaction. G. Horwitz. XXII, 299

ISOMERISM

Rotational isomerism of unbranched 1-alkenes by infrared spectra. L. A. Harrah. XXII, 93

ISOPROPYLBENZENE see Cumene

ISOTOPIC SULPHUR see Sulphur—Isotopes

JOB ANALYSIS

Information concepts in work analysis. D. K. Ross. XXII, 186

JOHN (BOOK OF THE NEW TESTAMENT) see Bible. N. T. John

JONSON, BEN, 1573?-1637

A study of the maturing of Ben Jonson's methods of characterization. M. K. Valian. XXII, 250

JOYCE, JAMES, 1882-1941

Space-time in James Joyce's thought: a study of the role of the artist in history. A. Thomson. XXII, 265

JUSTUM PRETIUM see Prices

K-MESONS see Mesons

KETONES

The Baeyer-Villiger oxidation of bicyclic ketones. G. P. Ahearn. XXII, 63

Rates of reaction of cyclopropyl and phenyl substituted ketones with sodium borohydride: ketone reactivity as a model for carbonium ion stability. R. Bernheimer. XXII, 65

Some coordination polymers prepared from bis-(β-diketones). J. S. Oh. XXII, 61

A study of the polarography and visible spectra of a series of copper chelates of 1, 3-diketones. H. D. Russell. XXII, 46

Utilization of alkyl isobutyl ketones in the Pfitzinger reaction. K. W. Bartz. XXII, 63

KIDNEYS

The effects of neurohypophysial hormones on electrolyte excretion and renal hemodynamics in dogs. W.-Y. Chan. XXII, 283

KLYSTRONS

A post acceleration klystron linear particle accelerator. M. F. Eisenberg. XXII, 208

KURTOSIS

An expression for the test characteristic kurtosis in terms of item parameters and an estimate of a quantity appearing in this expression. D. A. Goldstein. XXII, 331

LABOR AND CAPITAL see Industrial relations

LABOR AND LABORING CLASSES—WAGES see Wages

LABOR COLONIES see Agricultural colonies

LABOR RELATIONS see Industrial relations

LABOR REPRESENTATION IN REGULATION OF INDUSTRY see Employees' representation in management

LABOR-UNIONS see Trade-unions

LAMINARIN

Part I. The structure of laminarin. Part II. End-group analysis and the molecular weight of polysaccharides. A. M. Unrau. XXII, 57

LANDSCAPE IN LITERATURE see Nature in literature

LANGUAGE ARTS see Reading (Elementary)

LAPPING see Grinding and polishing

LATIN LANGUAGE—STUDY AND TEACHING

Factors and influences in the election of Latin by high school pupils. A. B. Bingham. XXII, 177

LATTICE THEORY

Higher degrees of distributivity in lattices of continuous functions. E. C. Weinberg. XXII, 276

LAW, EDUCATIONAL see Educational law and legislation

LAW, ROMAN see Roman law

LEACHING

Evaluation of sulphurous acid as a leaching agent for oxidized low grade nickel ores. L. P. Lenas. XXII, 197

LEAD SULPHIDE

A study of the incorporation of uranium by synthesized crystals of lead sulfide. J. J. Hutta. XXII, 278

LEAGUE OF NATIONS. INTELLECTUAL CO-OPERATION ORGANIZATION

A league of minds: the International Intellectual Cooperation Organization of the League of Nations. J. Kolasa. XXII, 314

LEARNING, PSYCHOLOGY OF

Asymptotic effects of absolute and differential magnitudes of reinforcement on instrumental performance. H. L. Klions. XXII, 335

Effect of early experience and age upon learning. S. A. Smith. XXII, 327

The effects of differential reinforcement of low rate on word utterance. E. E. Kapostins. XXII, 334

The effects of verbal and non-verbal reinforcement on the performance of schizophrenic subjects. N. D. Koppenhaver. XXII, 323

The generalization of verbal conditioning. A. M. L. Rosenberg. XXII, 326

A learning theory explanation of perceptual defense. K. Haas. XXII, 332

Parameter invariance in models for learning. C. F. Fey. XXII, 331

A pharmacological study of electrocortical activity and learning in the rat. C. Consalvi. XXII, 330

LEASES (ROMAN LAW)

A lease of an olive grove from the archive of Aurelius Isidorus (P. Col., Inv. no. 65). S. B. Porges XXII, 236

LEAST SQUARES

A decision procedure for the inclusion of an independent variable in a linear estimator. J. T. Webster. XXII, 275

LEAVES—ANATOMY

A blade tissue study of forty-seven species and varieties of aceraceae. H. O. Powers. XXII, 42

LEAVES, SHEDDING OF see Defoliation

LEWIS, WYNDHAM, 1886-1957

Shamanism and champagne: a critical introduction to the vorticist theory of Wyndham Lewis. J. H. Edman. XXII, 258

LIFE IMPRISONMENT

Homogeneity of first degree homicide cases as revealed by institutional characteristics. C. M. Unkovic. XXII, 353

LIGHT—SCATTERING

Causes of optical scatter in plagioclase feldspar. R. C. Doman. XXII, 278

LIGHT, ELECTROMAGNETIC THEORY OF see Electromagnetic theory

LIGHT, INVISIBLE see Spectrum, Infra-red

LIME—ELECTRIC PROPERTIES

Thermoelectric and optical properties of calcium oxide. H. H. Glascock, Jr. XXII, 298

LIME—OPTICAL PROPERTIES

Thermoelectric and optical properties of calcium oxide. H. H. Glascock, Jr. XXII, 298

LIMULUS

Effect of temperature on spontaneous and induced activity of arthropod nervous tissues. P. M. BeMiller. XXII, 33

LINKAGE (GENETICS)

The effects of linkage bias on estimates of genetic variance and the average degree of dominance for genes influencing quantitatively inherited characters in the F_2 and advanced generations of a hybrid population of corn. M. F. Lindsey. XXII, 35

LIPOPROTEINS

The isolation of cellular lipoproteins. E. A. Napier, Jr. XXII, 54

LIQUID METALS

Solubility of xenon in liquid metals. C. Mitra. XXII, 100

LIQUIDS

Individual mass transfer resistances in liquid-liquid extraction. S. H. Hong. XXII, 196

Individual phase behavior in liquid-liquid extraction. F. L. Poska. XXII, 200

LIQUIDS—DIFFUSION see Diffusion

LITERARY CRITICISM see Criticism

LITERATURE

Comments on art and literature from the personal writings of a group of well traveled, early American writers and artists. A critical collation. J. J. Lawler. XXII, 262

LITHOLOGY see Petrology

LIVER

Glucose utilization by rat liver. D. L. Di Pietro. XXII, 48

Influence of dietary protein on liver constituents of tuberculous and non-tuberculous guinea pigs. R. E. Bleiler. XXII, 242

Respiration and phosphorylation in heart and liver mitochondria isolated from altitude acclimatized rats. E. H. Strickland, Jr. XXII, 56

LOBBYING

Pressure groups in the Missouri legislative process. R. M. McClintock, Jr. XXII, 310

LOBLOLLY-PINE

Variation in loblolly pine (Pinus taeda L.). E. Thorbjornsen. XXII, 11

LOCAL FINANCE—CASE STUDIES

Financial reporting as a means of communication in a public jurisdiction. A. Nabavi. XXII, 315

LOCATION IN BUSINESS see Industries, Location of

LOGANIN

Structural studies of loganin. K. S. Sheth. XXII, 84

LOGIC, SYMBOLIC AND MATHEMATICAL

Foundations of acceptance. G. F. Rieman, Jr. XXII, 286

LOW TEMPERATURES

The heat capacity of several superconductors and other solids at very low temperatures. C. A. Bryant, Jr. XXII, 297

LOWER SILURIAN PERIOD see Geology, Stratigraphic—Ordovician

LUCERNE (PLANT) see Alfalfa

LUTHERAN CHURCH—DOCTRINAL AND CONTROVERSIAL WORKS

The community of faith and the word: an inquiry into the concept of the church in contemporary Lutheranism. K. S. Knutson. XXII, 342

MACARONI WHEAT see Wheat

MACROSIPHUM

Composite-feeding aphids of the genus Macrosiphum and two closely related genera in North Carolina (Homoptera: aphidae) with a host-plant list of Macrosiphum and related genera of the Eastern United States. A. T. Olive. XXII, 368

MAGNESIA

The hydration of magnesia. G. K. Layden, Jr. XXII, 197

MAGNESIUM—PHYSIOLOGICAL EFFECT

Magnesium studies with poultry. E. E. Gardiner. XXII, 8

MAGNETIC INDUCTION

Reversible and slow speed irreversible magnetization processes in 50 % nickel-iron alloys. L. L. Ogborn. XXII, 211

MAGNETIC RESONANCE, NUCLEAR see Nuclear magnetic resonance

MAGNETOSTRICTION

The use of magnetostriction to achieve fast adjustment of roll separation in multi-stand rolling mills. B. S. M. Granborg. XXII, 209

MAIZE

The effects of herbicidal chemicals on the activity of terminal oxidase enzymes in plant tissues. K. L. Hill. XXII, 303

The effects of linkage bias on estimates of genetic variance and the average degree of dominance for genes influencing quantitatively inherited characters in the F_2 and advanced generations of a hybrid population of corn. M. F. Lindsey. XXII, 35

Quantitative genetics of height in brachytic$_2$ corn. W. Prensky. XXII, 37

The relative efficiency of ear-to-row selection and convergent improvement breeding in the development of superior sweet corn inbreds and their hybrids. V. Ulrich. XXII, 39

A study of some physiological processes of corn as affected by N-(3, 4-dichlorophenyl) methacrylamide. H. H. Funderburk, Jr. XXII, 40

The uptake of potassium and rubidium-86 from the soil by corn roots. J. M. Walker. XXII, 5

MALE SEX HORMONES see Hormones, Sex

MAMMALS—INDIANA

The mammals of Indiana — history and current status. R. E. Mumford. XXII, 11

MAN—FOOD HABITS see Food habits

MANAGEMENT, EMPLOYEES' REPRESENTATION IN see Employees' representation in management

MANAGEMENT, INDUSTRIAL see Industrial management

MANGO

A study of the effect of growth substances on fruit-setting of the mango. T. T. Sturrock. XXII, 19

MANN, HORACE, 1796-1859

The contributions of Horace Mann, Mary Peabody Mann, and Elizabeth Peabody to art education in the United States. R. J. Saunders. XXII, 143

MANN, MARY TYLER (PEABODY) 1806-1887

The contributions of Horace Mann, Mary Peabody Mann, and Elizabeth Peabody to art education in the United States. R. J. Saunders. XXII, 143

MANSLAUGHTER see Homicide

MAPS

Identification of patterns on maps with special reference to data reduction for systems analysis. M. F. Dacey. XXII, 224

MARINE FAUNA

Commensal bacteria of marine animals — a study of their distribution, physiology and taxonomy. R. B. R. Colwell. XXII, 26

MARKOV PROCESSES

A theory for conformations in isotactic polymers; a Markov process. V. E. Meyer. XXII, 99

MARPECK, PILGRAM, d. 1556

The hermeneutics of Pilgram Marpeck. W. Klassen. XXII, 342

MARRIAGE

Communication and marital interaction: an exploratory study. H. E. Buchanan. XXII, 243

Development of the situational response test of marital interaction and adjustment. O. W. Morgan. XXII, 163

MASS MEDIA see Communication

MASS TRANSFER

The effect of mass transport on the carbon-carbon dioxide reaction. L. G. Austin. XXII, 191

Individual mass transfer resistances in liquid-liquid extraction. S. H. Hong. XXII, 196

Mass transfer and velocity of rise phenomena for single bubbles. J. H. Leonard. XXII, 197

A study of fluid flow and mass transfer in trickle-bed reactors. W. E. Schiesser. XXII, 201

MATHEMATICAL LOGIC see Logic, Symbolic and mathematical

MATHEMATICAL PHYSICS

The eigenvalues for certain cylindrical structures. D. M. Bolle. XXII, 208

MATHEMATICAL RESEARCH—SPANISH AMERICA

Mathematical research in Latin American universities. W. L. Furman. XXII, 269

MATRIMONY see Marriage

MAUNSELL, JOHN, 13th cent.

John Maunsell, the king's clerk, 1230-1265. J. O. Baylen. XXII, 32

MEASUREMENT, MENTAL see Mental tests

MEASUREMENT OF SOUND see Sound—Measurement

MEAT

Factors associated with the flavor of poultry meat. J. V. Spencer. XXII, 222

MEAT, FROZEN

Spectrophotometric estimation of metmyoglobin in frozen meat extracts. J. P. Lane. XXII, 221

MEDICAL PROFESSION see Physicians

MEDICINE, PHYSIOLOGICAL EFFECT OF see Pharmacology

MEDICINE AS A PROFESSION

The relationship between scores on the Strong vocational interest blank and academic performance at the State University of New York College of Medicine at Syracuse. S. E. Smith. XXII, 166

MELAND, BERNARD EUGENE, 1899-

A study in religious philosophy of higher education with special reference to the theistic naturalism of Bernard Eugene Meland and to the Biblical perspective. C. W. Whitworth. XXII, 344

MELOIDOGYNE

The reaction of several varieties of sweet potatoes to five species of root-knot nematodes (Meloidogyne spp.). M. J. Giamalva. XXII, 21

MEMORY

Parental recall of aspects of child development and of child-rearing practices. L. C. Robbins. XXII, 348

MENTAL PHILOSOPHY see Psychology

MENTAL TESTS

A study of the effect of music as a distractor on the mental test performance of certain eleventh grade students. T. B. Williams. XXII, 168

Validity concomitants of various scoring procedures which attenuate the effects of response sets and chance. K. D. Hopkins. XXII, 155

MENTALLY HANDICAPPED CHILDREN

A comparative investigation of the performance of mentally retarded and intellectually normal boys on selected reading comprehension and performance tasks. A. L. Shotick. XXII, 166

A factor analysis of an attitude scale toward retardation with a population of parents of educable mentally handicapped children. J. R. Hebeler. XXII, 154

MENTALLY HANDICAPPED CHILDREN—EDUCATION

The status of teachers of the educable mentally retarded. A. L. Rich. XXII, 127

MENTALLY HANDICAPPED CHILDREN—RECREATION

A manual for the administration of recreation programs for mentally defective children in state institutions for mental defectives. (Part one: The research. Part II: The manual, recreation for the mentally retarded) J. M. Lamm. XXII, 126

MERCURY

The mechanism of deoxymercuration and structure of mercurials in solution. L. L. Schaleger. XXII, 78

MESCALINE—PHYSIOLOGICAL EFFECT

Effects of mescaline on several behavior patterns in the rat, a psychopharmacological study. S. L. Chorover. XXII, 283

MESONS

Electromagnetic production of pion pairs. C. D. Zerby. XXII, 295

Photoproduction of single neutral pions at forward angles from hydrogen in the region from 700 to 1200 Mev. J. A. Waggoner. XXII, 295

Search for a π_o°. M. W. Gettner. XXII, 291

MESOTRONS see Mesons

METABOLIC ANTAGONISTS see Antimetabolites

METABOLISM

The effect of infection with pasteurella tularensis on the metabolism of white rats. G. J. Miraglia. XXII, 31

METALLIC FILMS

D. C. effects in ferromagnetic resonance of thin nickel films. W. G. Egan. XXII, 298

METALS—FATIGUE

Fatigue crack propagation in cubic metals. R. P. Wei. XXII, 215

METEORIC GLASS see Tektite

METEORITES

Phase-equilibrium studies on tektite and meteorite systems. W. A. Cassidy. XXII, 277

METHANOL see Wood-alcohol

METHIONINE

The distribution of S^{35} from labeled methionine among the plasma proteins of tumor-bearing and protein-depleted dogs. T. J. Russell, Jr. XXII, 55

METHOD OF LEAST SQUARES see Least squares

METHODIST EPISCOPAL CHURCH—MISSIONS

Fifty years of evangelical missionary movement in North Africa, 1881-1931. W. N. Heggoy. XXII, 238

METHYL ALCOHOL see Wood-alcohol

METHYL AMINE

The radiation induced exchange of carbon between ethane and methyl amine. P. S. Lamprey. XXII, 95

METHYL CYANIDE see Acetonitrile

METHYLINDOLCARBONIC ACID see Indolacetic acid

METRIC SPACES see Distance geometry

METRIC TOPOLOGY see Distance geometry

METROPOLITAN AREAS—U. S.

Planning for industrial development: with emphasis on the metropolitan area. C. J. Wingfield. XXII, 316

MEXICAN BEAN BEETLE

DDT-dehydrochlorinase in the Mexican bean beetle, Epilachna varivestis (Mul.). A. S. Tombes. XXII, 56

Substances from fungal ferments inhibitory to Mexican bean beetle (Epilachna varivestis Muls.) feeding. A. N. Kishaba. XXII, 367

MICROBES see Bacteriology; Viruses

MICROSPORUM GYPSEUM

Bordetella bronchiseptica induced porcine atrophic rhinitis. R. F. Cross. XXII, 233

MIGRATION, INTERNAL

A situational analysis of the effects of drouth as a disaster on the mobility of a selected rural-farm population. C. W. Ketch. XXII, 352

MILITARY BASES, BRITISH

The changing strategy of British bases. D. C. Armstrong, III. XXII, 313

MILK

Genetic relationships between lactation milk and fat yields and increases in production with age. J. R. Schabinger. XXII, 10

MILLET

Sudangrass and pearl millet development and productivity as influenced by cutting heights. D. A. Mays. XXII, 17

MILLS COUNTY, TEX.—RURAL CONDITIONS

A situational analysis of the effects of drouth as a disaster on the mobility of a selected rural-farm population. C. W. Ketch. XXII, 352

MIMULUS GUTTATUS

The crossing behavior and cytogenetics of Mimulus guttatus Fischer in the Bonneville Basin. D. W. Lindsay. XXII, 41

MIND see Intellect; Psychology

MISSIONS—AFRICA, NORTH

Fifty years of evangelical missionary movement in North Africa, 1881-1931. W. N. Heggoy. XXII, 238

MISSIONS, INDIAN see Indians of North America—Missions

MISSOURI—OCCUPATIONS

The occupational and geographical distribution of small town Missouri high school students: a pilot study. J. T. Howard. XXII, 351

MISSOURI. GENERAL ASSEMBLY

Pressure groups in the Missouri legislative process. R. M. McClintock, Jr. XXII, 310

MITOCHONDRIA

Respiration and phosphorylation in heart and liver mitochondria isolated from altitude acclimatized rats. E. H. Strickland, Jr. XXII, 56

MOBILITY see Migration, Internal; Social mobility

MODERN DANCE

The modern dance as dramatic theatre (a comparison of selected elements). M. L. Davis. XXII, 358

MOISTURE OF SOILS see Soil moisture

MOLD, VEGETABLE see Soils

MOLECULAR ASYMMETRY see Stereochemistry

MOLECULES

Dielectric relaxation times and structures of some nonrigid molecules. W. P. Purcell. XXII, 100

Part I. The visible spectrum of the gallium monohydride molecule. Part II. An evaluation of the coriolis interaction in asymmetric top molecules. M. L. Ginter. XXII, 93

MOLTEN METALS see Liquid metals

MOLYBDENUM

Strain aging effects in SAE 1018 steel & arc-cast molybdenum. G. W. Brock. XXII, 216

MOLYBDENUM—ISOTOPES

Directional correlation of successive gamma rays in Ba^{136} and Mo^{94}. H. Bernstein. XXII, 290

MONUMENTAL THEOLOGY see Christian antiquities

MORE, HENRY, 1614-1687

Henry More's Psychathanasia and Democritus Platonissans: a critical edition. L. Haring. XXII, 260

MOST FAVORED NATION CLAUSE see Favored nation clause

MOTHERS

Attitudes and personality characteristics of mothers and their relation to infantile colic. M. Brown. XXII, 319

Some effects of maternal inconsistency and emotionality level upon offspring behavior and development. D. R. Ottinger. XXII, 324

MOTION PICTURES see Moving-pictures

MOTION STUDY

The nature of individual differences in bodily forces exerted during a motor task as measured by a force-platform. J. W. Barany. XXII, 186

MOTIVATION (PSYCHOLOGY)

The development of a scale for motive assessment: achievement and affiliation. B. R. VanZandt. XXII, 175

Factors in motivation to work across three occupational levels. F. J. Anderson. XXII, 147

MOTIVATION RESEARCH (MARKETING)

An analysis of tertiary activity and consumer movement: the spatial structure of Ludhiana and Jullundur Districts, Punjab, in terms of central functions and the range of a central good. R. C. Mayfield. XXII, 225

MOTOR VEHICLE DRIVERS see Automobile drivers

MOULD, VEGETABLE see Soils

MOVING-PICTURES—EDITING

Some psychological aspects of motion picture montage. J. R. Gregory. XXII, 317

MOVING-PICTURES—HISTORY

A historical study of the development of American motion picture content and techniques prior to 1904. R. A. Sanderson. XXII, 235

MUNICIPAL UNIVERSITIES AND COLLEGES—MICHIGAN

Analysis of institutional objectives in Michigan community colleges. J. R. Kimball. XXII, 139

MUSCIDAE

The Nearctic genera of the tribe Anthomyiini (Muscidae, diptera) with a list of the Nearctic species. W. A. Drew. XXII, 366

MUSCULAR DYSTROPHY

The effects of certain compounds on experimental muscular dystrophy. N. Watzman. XXII, 284

MUSIC—AESTHETICS see Music—Philosophy and aesthetics

MUSIC—BIOGRAPHY see Music teachers

MUSIC—PHILOSOPHY AND AESTHETICS

A translation and critique of La musique et la vie intérieure by Lucien Bourguès and Alexandre Denéréaz (a psycho-musico-aesthetic study) parts I-III. G. B. Merchant. XXII, 281

MUSIC—PSYCHOLOGY

A study of the effect of music as a distractor on the mental test performance of certain eleventh grade students. T. B. Williams. XXII, 168

MUSIC TEACHERS

Some personality and temperament characteristics of selected school music teachers. G. W. Barth. XXII, 149

MUSICAL ACCENTUATION

Interdependence of word and tone in the dramatic music of Henry Purcell. J. C. P. Bicknell. XXII, 279

MUTATION (BIOLOGY) see Botany—Variation

MYOGLOBIN see Myohemoglobin

MYOHEMOGLOBIN

Spectrophotometric estimation of metmyoglobin in frozen meat extracts. J. P. Lane. XXII, 221

MYOSIN

A comparative study of embryonic and adult frog actomyosin. M. M. K. Nass. XXII, 368

MYROTHECIUM RORIDUM

Substances from fungal ferments inhibitory to Mexican bean beetle (Epilachna varivestis Muls.) feeding. A. N. Kishaba. XXII, 367

MYROTHECIUM VERRUCARIA

Studies on the inhibitor resistant respiration of the mycelium and particulate extracts from Myrothecium verrucaria. G. W. Kidder III. XXII, 40

NAMES, GEOGRAPHICAL—ENGLAND

A study of Old English words for demon and monster and their relation to English place-names. R. A. Peters. XXII, 253

NATIONAL CHARACTERISTICS, AMERICAN

A history of self-made manhood: the ideal of the self-made man in nineteenth century America. J. G. Cawelti. XXII, 254

NATIONAL PRODUCT, GROSS see Gross national product

NATIONAL PSYCHOLOGY see National characteristics

NATIONAL SOCIALISM IN LITERATURE

Antinationalsozialistische Gestalten im deutschen Nachkriegsroman. [German text] J. Kempers. XXII, 261

NATURAL SCIENCE see Science

NATURE IN LITERATURE

The idea of nature in the poetry of William Blake. L. A. Waters, Jr. XXII, 265

NEMATODE DISEASES OF PLANTS

Investigation of the relationships of plant-parasitic nematodes to the stunting of pines in outplantings. J. L. Ruehle. XXII, 22

Nematodes associated with carnations, Dianthus caryophyllus L., in New Jersey with special reference to the parasitism and biology of Criconemoides curvatum Raski. H. T. Streu. XXII, 369

NEOCENE EPOCH see Geology, Stratigraphic—Neocene

NEOPLASMS see Tumors

NERNST EFFECT see Ettingshausen-Nernst effect

NERVOUS SYSTEM—ARTHROPODA

Effect of temperature on spontaneous and induced activity of arthropod nervous tissues. P. M. BeMiller. XXII, 33

NETWORKS, ELECTRIC see Electric networks

NEUTRONS

An apparatus for measuring fast neutron polarization and a measurement of D(d, n)He^3 neutron polarization. M. S. Zucker. XXII, 296

Fast neutron-nucleus interactions. D. W. Kent, Jr. XXII, 292

Fast-neutron total cross sections of beryllium, carbon, and oxygen. D. B. Fossan. XXII, 291

Search for a π_o^o. M. W. Gettner. XXII, 291

NEWS, FOREIGN see Foreign news

NEWS BROADCASTS see Radio journalism

NICKEL

Coordination compounds of nickel (II). D. G. Karipides. XXII, 59

D. C. effects in ferromagnetic resonance of thin nickel films. W. G. Egan. XXII, 298

NICKEL ORES

Evaluation of sulphurous acid as a leaching agent for oxidized low grade nickel ores. L. P. Lenas. XXII, 197

NICKEL-PLATING

Mechanism of bright electroplating: laminations and periodicity in the deposition of nickel and copper. N. Vanderkooi, Jr. XXII, 102

NITRATES

A study of the oxidation of thiocyanate by acidic nitrite and nitrate solutions. W. A. Biggart II. XXII, 87

NITRITES

A study of the oxidation of thiocyanate by acidic nitrite and nitrate solutions. W. A. Biggart II. XXII, 87

NITROGEN FERTILIZERS

Influence of nitrogen and phosphorus fertilizers on the morphology and physiology of soybean roots. S. R. Wilkinson. XXII, 6

Nitrogen-potassium ratios, clipping height and clipping frequency as variables influencing yield, persistence and chemical composition of orchardgrass. W. K. Griffith. XXII, 3

A study of the mineralizable nitrogen fraction of selected North Carolina soils and its relation to crop responses to applied fertilizer nitrogen. C. D. Welch. XXII, 5

A study of the root and top growth of several forage species as influenced by nitrogen and irrigation treatments. W. H. Mitchell. XXII, 17

NITROGEN IN SOILS see Soils—Nitrogen content

NITROGEN OXIDES

Cross section for dissociative recombination of nitric oxide. B. E. Squires, Jr. XXII, 294

NON-GRADED SCHOOLS see Ability grouping in education

NON-WAGE PAYMENTS—U. S.

An analysis of the fringe benefit programs of seven large corporations and seven large school systems. W. H. Kanzler. XXII, 139

NORRIS, GEORGE WILLIAM, 1861-1944

The political philosophy of George W. Norris. N. L. Zucker. XXII, 312

NORTH AMERICAN INDIANS see Indians of North America

NUCLEAR MAGNETIC RESONANCE

Deuteron jumping in KD_2PO_4. V. H. Schmidt. XXII, 300

NUCLEAR OPTICAL MODELS

Fast neutron-nucleus interactions. D. W. Kent, Jr. XXII, 292

NUCLEAR PARTICLES see Particles (Nuclear physics)

NUCLEAR REACTIONS

Analysis of some deuteron-induced reactions in oxygen - 18. J. C. Armstrong. XXII, 290

An investigation of the nuclear reactions $C^{12}(\alpha, p)N^{15*}$, $Al^{27}(\alpha, p)Si^{30*}$, and $P^{31}(\alpha, p)S^{34*}$ at 42 Mev. A. J. Lieber. XXII, 292

Measurements of $N^{14}+\alpha$, $O^{16}+He^3$, and $O^{16}+\alpha$ differential cross sections. E. A. Silverstein. XXII, 294

Study of K^+N scattering in the double dispersion representation. B. W. Lee. XXII, 292

Velocity-dependent nuclear forces. M. M. Razavy. XXII, 294

NUCLEAR REACTORS

Experimental study of nuclear reaction internal noise and transfer function using random reactivity variations and correlation analysis. V. Rajagopal. XXII, 212

NUCLEAR TRANSFORMATIONS see Nuclear reactions

NUCLEAR TRANSMUTATION see Nuclear reactions

NUCLEONS see Particles (Nuclear physics)

NUTRITION OF PLANTS see Plants—Nutrition

OCCUPATIONAL APTITUDE TESTS see Ability—Testing

OCCUPATIONAL SURVEYS

The occupational and geographical distribution of small town Missouri high school students: a pilot study. J. T. Howard. XXII, 351

OCCUPATIONS IN LITERATURE

James Gould Cozzens and the professional man in American fiction. W. G. Wiegand. XXII, 266

OESTRUM see Estrus

OFFICE EMPLOYEES see Clerks

OHM'S LAW

A microwave technique for the study of deviations from Ohm's law in high resistivity semiconductors. K. Rose. XXII, 213

OLD ENGLISH LANGUAGE see Anglo-Saxon language

OLEFINES

Rotational isomerism of unbranched 1-alkenes by infrared spectra. L. A. Harrah. XXII, 93

Part I: Synthetic approaches to tetracyclines. Part II: Mechanism of the reaction of carbonyl cyanide with olefins. Part III: Alkylation of dienamines. G. I. Birnbaum. XXII, 65

OPTICAL PROPERTIES OF MATERIALS see Lime—Optical properties

ORAL READING

Duration of oral reading times and sound pressure level under conditions of delay and intensity of side-tone transmission. F. G. Attanasio. XXII, 357

ORATORS, GREEK

Salamis and Plataea in the tradition of the Attic orators. F. W. Schlatter, S. J. XXII, 252

ORCHARD GRASS

Nitrogen-potassium ratios, clipping height and clipping frequency as variables influencing yield, persistence and chemical composition of orchardgrass. W. K. Griffith. XXII, 3

ORDOVICIAN FORMATION see Geology, Stratigraphic—Ordovician

ORGANIC CHEMISTRY see Chemistry, Organic

ORIENTATION (STUDENTS) see Students

OUTDOOR RELIEF see Charities

OVALBUMIN

Preparation and chemical studies of glycopeptides derived from ovalbumin. R. H. Nuenke. XXII, 54

OVUM

Investigations associated with the transplantation of bovine ova. T. L. Avery. XXII, 302

OXIDASES

The effects of herbicidal chemicals on the activity of terminal oxidase enzymes in plant tissues. K. L. Hill. XXII, 303

OXIDATION

Autoxidation inhibition in cumene. P. L. Weinle. XXII, 83

The Baeyer-Villiger oxidation of bicyclic ketones. G. P. Ahearn. XXII, 63

Higher oxidation states of silver. M. Usategui. XXII, 63

Three studies in the oxidation of organic sulfur compounds. L. S. Levitt. XXII, 73

OXYGEN

Fast-neutron total cross sections of beryllium, carbon, and oxygen. D. B. Fossan. XXII, 291

OXYGEN—ISOTOPES

Analysis of some deuteron-induced reactions in oxygen - 18. J. C. Armstrong. XXII, 290

PALLADIUM

An adiabatic demagnetization study of palladium and palladium hydride. H. J. Maria. XXII, 99

The crystal structures of some palladium amalgams and of the mineral potarite. K. Terada. XXII, 101

PANGENESIS see Heredity; Reproduction

PANMYCIN see Tetracycline

PAPAIN

The sulphur distribution of papain and related studies. A. N. Glazer. XXII, 50

PAPAYOTIN see Papain

PAPER MAKING AND TRADE

A kinetic study of the chlorination of unbleached kraft pulp. V. D. Chapnerkar. XXII, 192

PAPOID see Papain

PARANOIA

Distortions in the perception of self and others by persons using paranoid defenses. P. H. Havener. XXII, 322

PARENT AND CHILD

Attitudes and personality characteristics of mothers and their relation to infantile colic. M. Brown. XXII, 319

A factor analysis of an attitude scale toward retardation with a population of parents of educable mentally handicapped children. J. R. Hebeler. XXII, 154

PARENTS AND TEACHERS see Home and school

PARISH SCHOOLS see Church schools

PARTICLE, DYNAMICS OF A see Dynamics of a particle

PARTICLE ACCELERATORS

A post acceleration klystron linear particle accelerator. M. F. Eisenberg. XXII, 208

PARTICLES (NUCLEAR PHYSICS)

Nucleon-nucleon (L• S) interaction from nucleon spin 3/2 isobar model. L. M. Noble. XXII, 293

PATRIARCHY see Family

PEABODY, ELIZABETH PALMER, 1804-1894

The contributions of Horace Mann, Mary Peabody Mann, and Elizabeth Peabody to art education in the United States. R. J. Saunders. XXII, 143

PEAR

Studies on the nutrition of bartlett pear trees (Pyrus communis L.) and fire blight (Erwinia amylovora, Burr.). L. N. Lewis. XXII, 16

PEDAGOGY see Education; Teaching

PEDOLOGY (CHILD STUDY) see Child study; Children

PELAGIC FAUNA see Marine fauna

PENN, WILLIAM, 1644-1718

A rhetorical analysis of the oratory of William Penn. J. J. Hopkins. XXII, 359

PENNSYLVANIA. STATE CORRECTIONAL INSTITUTION, PITTSBURGH

Homogeneity of first degree homicide cases as revealed by institutional characteristics. C. M. Unkovic. XXII, 353

PEPTIDES

The synthesis of peptides related to α-melanocyte stimulating hormone and the corticotropins. S. Lande. XXII, 52

PERCEPTION

Distortions in the perception of self and others by persons using paranoid defenses. P. H. Havener. XXII, 322

An examination of perceptual and cognitive rigidity in deaf adolescent boys. M. H. Wodin. XXII, 329

A learning theory explanation of perceptual defense. K. Haas. XXII, 332

PERIPLANETA AMERICANA

Effect of temperature on spontaneous and induced activity of arthropod nervous tissues. P. M. BeMiller. XXII, 33

PERSONALITY

The effects of group counseling on interpersonal relationships, anxiety level, intellectual functioning, and certain personality characteristics in a planned workshop experience. M. Reiser. XXII, 325

PERSONALITY—TESTING

The consistency of individual differences in conditionability in a verbal conditioning situation. T. J. Scott. XXII, 337

Personality correlates of picture preferences. G. Cerbus. XXII, 319

The psychogrammatical homograph test: an investigation of certain aspects of grammatical usage in relation to certain aspects of personality. R. J. Decker. XXII, 320

PERSONNEL CLASSIFICATION see Job analysis

PERSONNEL SERVICE IN HIGHER EDUCATION

Survey of freshman orientation programs in the six publicly supported universities in Michigan and including a review of the development of student personnel services in American higher education with emphasis on freshman orientation. N. B. M. Daisher. XXII, 134

PERSONNEL SERVICE IN SECONDARY EDUCATION

A factorial analysis of personal-social problem-solving abilities of high school students. A. E. Abu ELnasr. XXII, 345

A study of the guidance resources of students in high schools affiliated with the National Union of Christian Schools in Michigan and Illinois. L. J. Harvey. XXII, 153

PERYLENES

The syntheses of isomeric alkylperylenes and the perylene monocarboxylic acids. H. E. Zieger. XXII, 84

PETROGRAPHY see Petrology

PETROLOGY—ARIZONA

A study of the distribution of trace elements in some igneous rocks of northwestern and central Arizona. G. W. Putman. XXII, 230

PETT, PETER. TIMES JOURNEY TO SEEKE HIS DAUGHTER TRUTH

Times journey to seeke his daughter Truth: and Truths letter to fame of Englands excellencie by Peter Pett: a critical edition with introduction and notes. R. S. Davis. XXII, 256

PFITZINGER REACTION

Utilization of alkyl isobutyl ketones in the Pfitzinger reaction. K. W. Bartz. XXII, 63

PHARMACEUTICAL INDUSTRY see Drug trade

PHARMACOLOGY

Cytotoxicity of antibacterial agents. M. H. Ruether. XXII, 284

PHASE RULE AND EQUILIBRIUM

Phase equilibrium and crystal chemical relationships in rare earth systems. I. Warshaw. XXII, 279

Phase-equilibrium studies on tektite and meteorite systems. W. A. Cassidy. XXII, 277

PHENOLS

Part one: Sorption of phenol by low-capacity ion-exchange resins. Part two: An analytical and kinetic study of a chelating resin. R. S. Turse. XXII, 46

PHILADELPHIA—POLITICS AND GOVERNMENT —CIVIL WAR

Civil War issues in Philadelphia, 1856-1865. W. W. Dusinberre. XXII, 237

PHILANTHROPY see Charities

PHILOSOPHY OF HISTORY see History—Philosophy

PHONIUM BROMIDES

The preparation and polymerization of some diallyl- and dimethallyphosphonium bromides. D. L. Skinner. XXII, 80

PHONOLOGY see Arabic language—Phonology

PHOSPHINE

Fluorocarbon polyphosphine chemistry. L. R. Grant, Jr. XXII, 59

PHOSPHONIUM ALKOXIDES

Part I: Studies of the decomposition of tetra-substituted phosphonium alkoxides. Part II: Copper ion-catalyzed reactions of t-butyl perbenzoate with alkylbenzenes. L. J. Ross. XXII, 78

PHOSPHORETTED HYDROGEN see Phosphine

PHOSPHORUS ACIDS

A study of the separation of phosphorus acids. F. Jakob. XXII, 45

PHOSPHORUS FERTILIZERS

The effect of phosphorus and potassium on the botanical and chemical composition, yield, and persistence of alfalfa and certain grasses grown in combination. J. N. Pratt. XXII, 18

Influence of nitrogen and phosphorus fertilizers on the morphology and physiology of soybean roots. S. R. Wilkinson. XXII, 6

PHOSPHORUS HYDRIDE see Phosphine

PHOTOELASTICITY

A contribution to photoelastic structural stability analysis. W. L. Bingham. XXII, 216

PHOTOGRAPHY—MOVING-PICTURES see Cinematography; Moving-pictures

PHOTONUCLEAR REACTIONS

Photoproduction of single neutral pions at forward angles from hydrogen in the region from 700 to 1200 Mev. J. A. Waggoner. XXII, 295

PHYSA HALEI

A study of the glycolytic enzymes in the aquatic snail Physa halei Lea. C. G. Beames, Jr. XXII, 364

PHYSICAL CHEMISTRY see Chemistry, Physical and theoretical

PHYSICAL EDUCATION AND TRAINING—TEACHER TRAINING

An evaluation of a teacher education program in health and physical education. L. C. Schwich. XXII, 145

PHYSICAL EDUCATION AND TRAINING—INDIA

The development of professional education principles for physical education colleges in India. H. Singh. XXII, 146

PHYSICAL EDUCATION FOR WOMEN

An evaluation of selected physical education activities for college women: a comparative analysis of physical education activities to determine their educational potentials. M. E. Rogers. XXII, 145

PHYSICIANS—U. S.

The role of the detail man in the diffusion and adoption of an ethical pharmaceutical innovation within a single medical community. R. R. Rehder. XXII, 118

PHYSICS, ASTRONOMICAL see Astrophysics

PHYSIOGRAPHY see Geology

PHYSIOLOGICAL EFFECT OF CAFFEIN [GAMMA RAYS, MAGNESIUM, MESCALINE] see Caffein [Gamma rays, Magnesium, Mescaline]—Physiological effect

PHYSIOLOGICAL EFFECT OF CHEMICALS see Pharmacology

PHYSIOLOGICAL PSYCHOLOGY see Psychology, Physiological

PHYTOGRAPHY see Botany

PHYTOLOGY see Botany

PIG see Swine

PINE—DISEASES AND PESTS

Investigation of the relationships of plant-parasitic nematodes to the stunting of pines in outplantings. J. L. Ruehle. XXII, 22

PIONS see Mesons

PIPE

A theoretical analysis of the decay of secondary flow following a pipe bend. C. C. Shih. XXII, 189

PIPERAZIDINE see Piperazine

PIPERAZINE

Coordination chemistry of piperazine and piperazine derivatives. F. W. Obear. XXII, 61

Syntheses and characterization of some 3, 4, 5-trimethoxybenzoyl; 3, 4, 5-trimethoxybenzyl; and 3, 4, 5-trimethoxyphenylethyl derivatives of piperazine and some related compounds. B. Silverman. XXII, 80

PISCES see Fishes

PITTSBURGH—CITY PLANNING see Cities and towns—Planning—Pittsburgh

PLACE-NAMES see Names, Geographical

PLACEBO (MEDICINE)

The effects of epinephrine, chlorpromazine, and dibenzyline upon the fright responses of rats under stress and non-stress conditions. J. E. Singer. XXII, 318

PLANNING

An analysis of the long-range planning process in a select group of business firms. R. H. Bock. XXII, 115

PLANNING, CITY see Cities and towns—Planning

PLANS see Maps

PLANT-BREEDING

The relative efficiency of ear-to-row selection and convergent improvement breeding in the development of superior sweet corn inbreds and their hybrids. V. Ulrich. XXII, 39

PLANT NUTRITION see Plants—Nutrition

PLANT REGULATORS see Growth inhibiting substances; Growth promoting substances

PLANTATIONS—YUCATAN

Some geographic aspects of plantation agriculture in Yucatan. R. E. P. Chardon. XXII, 223

PLANTING see Agriculture

PLANTS—NUTRITION

Studies on the nutrition of bartlett pear trees (Pyrus communis L.) and fire blight (Erwinia amylovora, Burr.). L. N. Lewis. XXII, 16

PLANTS, EFFECT OF TEMPERATURE ON

A study of the effect of temperature levels of germination environment on chemical and physical characteristics of cotton seedlings. M. N. Christiansen. XXII, 14

PLASMA (IONIZED GASES)

A study of the time lag of gas breakdown in reversed electric fields. H. W. Kendall. XXII, 289

PLASMA PROTEINS

The distribution of S^{35} from labeled methionine among the plasma proteins of tumor-bearing and protein-depleted dogs. T. J. Russell, Jr. XXII, 55

PLASTIC MATERIALS see Plastics

PLASTICITY

Dynamics of an elastic-Bingham body. W. P. Acheson. XXII, 267

A slip-line theory of plasticity. R. E. Llorens. XXII, 216

Stability of elastic and partially plastic frames. L.-W. Lu. XXII, 206

PLASTICS

Power absorption of Bingham plastics in rotational devices. R. H. Schwaar. XXII, 201

PLATAEA, BATTLE OF, 479 B. C.

Salamis and Plataea in the tradition of the Attic orators. F. W. Schlatter, S. J. XXII, 252

PLUMBOUS SULPHIDE see Lead sulphide

POLARIZATION (ELECTRICITY)

The longitudinal polarization of electrons from Pm^{147}. C. Chasman. XXII, 291

POLISHING see Grinding and polishing

POLITICS, PRACTICAL

Personality and politics: a qualitative analysis of the basic factors of political success. S. Ebbin. XXII, 309

POLLS see Elections; Voting

POLLUTION OF WATER see Water—Pollution

POLYCYCLINE see Tetracycline

POLYMERS AND POLYMERIZATION

Electron exchange polymers from disubstituted hydroquinones and formaldehyde. R. K. Quisenberry. XXII, 76

On the dimensions of linear polymers. C. A. von Frankenberg. XXII, 103

Preparation of stereospecific polymers through a cyclic polymerization mechanism. W. L. Miller. XXII, 76

Some coordination polymers prepared from bis-(β-diketones). J. S. Oh. XXII, 61

Studies in equilibrium polymerization. A. Eisenberg. XXII, 89

A theory for conformations in isotactic polymers; a Markov process. V. E. Meyer. XXII, 99

POLYMETHYLENE

The synthesis of polymethylene-bridged diphosphine dioxides. R. F. Struck. XXII, 82

POLYPHOSPHATES

An electrical transport study of polyphosphates. S. Bluestone. XXII, 87

POLYPROPYLENE

Electron spin resonance spectroscopy in irradiated polypropylenes. T. Buch. XXII, 88

POLYSACCHARIDES

Part I. The structure of laminarin. Part II. End-group analysis and the molecular weight of polysaccharides. A. M. Unrau. XXII, 57

POLYTONALITY see Tonality

POOR RELIEF see Charities

PORTLAND CEMENT

A study of chert and shale gravel in concrete. R. L. Schuster. XXII, 207

POSITION ANALYSIS see Topology

POTARITE

The crystal structures of some palladium amalgams and of the mineral potarite. K. Terada. XXII, 101

POTASSIUM FERTILIZERS

The effect of phosphorus and potassium on the botanical and chemical composition, yield, and persistence of alfalfa and certain grasses grown in combination. J. N. Pratt. XXII, 18

Nitrogen-potassium ratios, clipping height and clipping frequency as variables influencing yield, persistence and chemical composition of orchardgrass. W. K. Griffith. XXII, 3

POTASSIUM IN SOILS see Soils—Potassium content

POTASSIUM PHOSPHATES

Deuteron jumping in KD_2PO_4. V. H. Schmidt. XXII, 300

POTASSIUM SALTS

A kinetic study of the acid catalyzed hydrolysis of the di-potassium salt of diazomalonic acid. C. H. Geisler. XXII, 92

POTENTIAL, THEORY OF

Nucleon-nucleon (L•S) interaction from nucleon spin 3/2 isobar model. L. M. Noble. XXII, 293

POULTRY

Factors associated with the flavor of poultry meat. J. V. Spencer. XXII, 222

Heat and moisture production of mature leghorn chickens. H. V. Walton. XXII, 190

Magnesium studies with poultry. E. E. Gardiner. XXII, 8

Relationships among factors affecting the quality of poultry. J. D. Mitchell. XXII, 9

Requirement of avian C'1 for fixation of guinea pig complement by avian antibody-antigen complexes. H. N. Benson. XXII, 7

POULTRY BREEDING

The effect of selection on genetic variances and covariances of some traits of the fowl. G. W. Friars. XXII, 8

POULTRY HOUSES AND EQUIPMENT

Heat and moisture production of mature leghorn chickens. H. V. Walton. XXII, 190

POWER-PLANTS

A study of coal dust control in power plants. C. W. Krusé. XXII, 233

PRACTICAL POLITICS see Politics, Practical

PRACTICE TEACHING see Student teaching

PRECIPITATION (CHEMISTRY)

Studies in coprecipitation. W. P. Tappmeyer. XXII, 62

Thermochemical precipitation titrimetry and precipitation thermodynamics in aqueous solutions and molten salts. E. J. Billingham, Jr. XXII, 44

PRECIPITIN see Serum

PREDICTION OF SCHOLASTIC SUCCESS

An empirical comparison of the school and college ability tests and the American Council on Education psychology examination. R. B. Clyde. XXII, 151

Prediction of student academic achievement in beginning German at Purdue University. W. M. Hill. XXII, 154

The relationship between scores on the Strong vocational interest blank and academic performance at the State University of New York College of Medicine at Syracuse. S. E. Smith. XXII, 166

A study of nonintellectual factors related to academic achievement among college seniors at Ball State Teachers College. J. G. Hunt. XXII, 157

A study of the effectiveness of the Kuder preference record-vocational in discriminating among Purdue engineering graduates. D. M. McMillen. XXII, 162

PREGNANCY

Effects of dietary sodium levels upon maternal responses of pyridoxine- and deoxypyridoxine-fed pregnant rats. A. Kirksey. XXII, 243

The influence of ambient temperature on early pregnancy loss as determined by embryo transfer. C. W. Alliston. XXII, 301

PRESCHOOL READERS AND SPEAKERS see Readers and speakers

PRESERVATION OF FORESTS see Forests and forestry

PRESSURIZED WATER REACTORS

Nuclear and thermal design considerations for soluble-poison controlled nuclear reactors. P. L. Hofmann. XXII, 218

PRICES—U. S.

Wage and non-wage shares in business product, 1899-1929. A. I. Grant. XXII, 107

PRIMARY EDUCATION see Education, Primary

PRINCIPALS, SCHOOL see School superintendents and principals

PROBABILITIES

Available soil moisture as a stochastic process. D. E. Cooper. XXII, 268

Mixtures of stochastic processes. D. A. Freedman. XXII, 268

PROBLEM SOLVING

A factorial analysis of personal-social problem-solving abilities of high school students. A. E. Abu ELnasr. XXII, 345

PRODUCTION CREDIT ASSOCIATION, LINCOLN, NEB.

Competition between commercial banks and a production credit association: a case study. K. D. Patterson. XXII, 108

PROFESSIONS IN LITERATURE see Occupations in literature

PROFIT—U. S.

Wage and non-wage shares in business product, 1899-1929. A. I. Grant. XXII, 107

PROGNOSIS OF SCHOLASTIC SUCCESS see Prediction of scholastic success

PROMETHIUM—ISOTOPES

The longitudinal polarization of electrons from Pm^{147}. C. Chasman. XXII, 291

PROOF see Evidence

PROPANOIC ACID

Studies directed toward a determination of the absolute configuration of an optically active diphenyl: the synthesis of 5-acetamino-1, 2, 3, 4-tetrahydronaphthalene-2-γ-propanoic acid. A. J. Rich. XXII, 77

PROTEIDS see Proteins

PROTEIN METABOLISM

The distribution of S^{35} from labeled methionine among the plasma proteins of tumor-bearing and protein-depleted dogs. T. J. Russell, Jr. XXII, 55

PROTEINASE, ALKALI see Trypsin

PROTEINS

Factors affecting the interrelationships involved in protein synthesis. P. B. Hill. XXII, 29

Influence of dietary protein on liver constituents of tuberculous and non-tuberculous guinea pigs. R. E. Bleiler. XXII, 242

PROTEOLYTIC ENZYMES

Studies on the proteolytic enzyme system of skin and its relationship to a state of hypersensitivity. J. Golubow. XXII, 51

PROTESTANT CHURCHES—MISSIONS

Fifty years of evangelical missionary movement in North Africa, 1881-1931. W. N. Heggoy. XXII, 238

Protestant missionaries to the American Indians, 1787 to 1862. R. F. Berkhofer, Jr. XXII, 25

PSEUDOMONAS FLUORESCENS

The microbiological degradation of streptomycin. D. Klein. XXII, 30

PSYCHOGRAMMATICAL HOMOGRAPH TEST

The psychogrammatical homograph test: an investigation of certain aspects of grammatical usage in relation to certain aspects of personality. R. J. Decker. XXII, 320

PSYCHOLOGICAL TESTS see Mental tests

PSYCHOLOGY

The effect of irrelevant environmental stimulation on vigilance performance. J. J. McGrath. XXII, 336

PSYCHOLOGY, CHILD see Child study

PSYCHOLOGY, COMPARATIVE

Some effects of maternal inconsistency and emotionality level upon offspring behavior and development. D. R. Ottinger. XXII, 324

PSYCHOLOGY, EXPERIMENTAL see Psychology, Physiological

PSYCHOLOGY, NATIONAL see National characteristics

PSYCHOLOGY, PHYSIOLOGICAL

Comparison of monocular and binocular color matching. C. S. Hoffman. XXII, 332

Effect of early experience and age upon learning. S. A. Smith. XXII, 327

An investigation of the effects of some schedules of intermittent reinforcement on the precisely timed response of the rat. H. W. Barnes. XXII, 329

PSYCHOLOGY, PHYSIOLOGICAL (Continued)

Parameter invariance in models for learning. C. F. Fey. XXII, 331

A pharmacological study of electrocortical activity and learning in the rat. C. Consalvi. XXII, 330

PSYCHOLOGY OF LEARNING see Learning, Psychology of

PSYCHOPHYSICS see Psychology, Physiological

PUBLIC FINANCE see Finance, Public

PUBLIC SCHOOLS—BUSINESS MANAGEMENT

An evaluation of the assignments and levels of public school business functions. D. R. Ellis. XXII, 135

PUBLIC SCHOOLS—MICHIGAN—WAYNE COUNTY —CURRICULA

Evaluation of curriculum development practices in selected school systems of Wayne County, Michigan. J. L. Godbey. XXII, 136

PUBLIC SPEAKING

A historical study of speech education at the University of Southern California (1880 through 1950). E. W. Priddy. XXII, 361

PURCELL, HENRY, 1658 or 9-1695

Interdependence of word and tone in the dramatic music of Henry Purcell. J. C. P. Bicknell. XXII, 279

PURPLE MEDIC see Alfalfa

PYRENE

The chemistry of pyrene. Y.-H. Chang. XXII, 68

PYRIDINE

Solvolysis kinetics of pyridine-boranes. E. R. Birnbaum. XXII, 58

PYRIDOXINE

Effects of dietary sodium levels upon maternal responses of pyridoxine- and deoxypyridoxine-fed pregnant rats. A. Kirksey. XXII, 243

PYRIMIDINES

I. The partial purification and properties of a germination inhibitor(s) isolated from apple seed. II. Pyrimidine metabolism in germinating seedlings. W. R. Evans. XXII, 49

The synthesis of some substituted pyrimido (4, 5-d) pyrimidines. M. Dymicky. XXII, 69

QUADRATIC TRANSFORMATIONS see Transformations, Quadratic

QUARTIC CURVES see Curves, Quartic

QUEUING THEORY

Augmentation techniques in the theory of queues. D. M. G. Wishart. XXII, 276

QUICKSILVER see Mercury

QUINONE

An addition reaction of the plant growth hormone. T. H. Plummer, Jr. XXII, 18

QUOTATIONS, AMERICAN

Comments on art and literature from the personal writings of a group of well traveled, early American writers and artists. A critical collation. J. J. Lawler. XXII, 262

RADIATION, STELLAR see Stars—Radiation

RADIATION CHEMISTRY see Radiochemistry

RADIO JOURNALISM

Editorializing in broadcasting. M. A. Cusack. XXII, 357

RADIO NEWS see Radio journalism

RADIOACTIVE ISOTOPES see Radioisotopes

RADIOCHEMISTRY

The radiation chemistry of coal in various atmospheres. A. Weinstein. XXII, 203

The radiation induced exchange of carbon between ethane and methyl amine. P. S. Lamprey. XXII, 95

RADIOCOBALT see Cobalt—Isotopes

RADIOISOTOPES

Measurements of $N^{14}+\alpha$, $O^{16}+He^{3}$, and $O^{16}+\alpha$ differential cross sections. E. A. Silverstein. XXII, 294

RAIN AND RAINFALL

Effects of rainfall energy on some physical properties of soils. K. M. Sor. XXII, 4

RANA see Frogs

RARE EARTH METALS

A study of the effect of certain rare earth elements on the alpha-beta transformation of zirconium. L. C. Ianniello. XXII, 217

RARE EARTHS see Earths, Rare

RATIO AND PROPORTION

The Epistola de proportione et proportionalitate of Ametus Filius Iosephi. Sister M. W. R. Schrader, O. P. XXII, 272

RATIONALIZATION OF INDUSTRY see Industrial management

RATS

The effect of infection with pasteurella tularensis on the metabolism of white rats. G. J. Miraglia. XXII, 31

RAYS, INVISIBLE see Spectrum, Infra-red

RAYS, ULTRA-VIOLET see Ultra-violet rays

REACTION RATE (CHEMISTRY) see Chemical reaction, Rate of

REACTIONS, CHEMICAL see Chemical reactions

REACTORS (NUCLEAR PHYSICS) see Nuclear reactors

READABILITY (LITERARY STYLE)

An investigation of the suitability of six reading selections designed for sixth-grade pupils. T. G. Foster. XXII, 123

Readability as a key for evaluating junior college freshman English anthologies. M. Doyle. XXII, 180

READERS AND SPEAKERS

An investigation of the suitability of six reading selections designed for sixth-grade pupils. T. G. Foster. XXII, 123

READERSHIP SURVEYS

Meaning intensity as related to readership of foreign news. J. T. McNelly. XXII, 347

READING (ELEMENTARY)

The construction and validation of a test of ten teacher skills used in reading instruction, grades 2-5. E. W. Wade. XXII, 167

The relationship between patterns of reading instruction and reading achievement in the primary grades. F. B. Sperry. XXII, 129

Relationships between difficulty levels of assigned texts and reading ability of elementary school pupils. H. B. Truher. XXII, 164

READING (HIGHER EDUCATION)

Some apparent results of college reading improvement programs reconsidered in terms of the method of measuring improvement. R. C. Hardison. XXII, 152

READING, ORAL see Oral reading

REASONING

"What if everyone did that?". J. H. Sobel XXII, 286

RECITATIONS see Readers and speakers

RECTIFICATION OF SPIRITS see Distillation

REDEVELOPMENT, URBAN see Cities and towns —Planning

REFORMED CHURCH IN THE UNITED STATES —HISTORY

Revivalism in the German Reformed Church in America to 1850, with emphasis on the Eastern synod. J. B. Frantz. XXII, 238

RELIEF (AID) see Charities

RELIGION AND ART see Art and religion

RELIGION AND WAR see War and religion

RELIGIOUS EDUCATION—TEACHER TRAINING

An investigation of the training needs of lay religious educators in conservative Baptist churches in southern Michigan. D. E. Gillespie. XXII, 169

RELIGIOUS HISTORY see Church history

REPRODUCTION

Reproductive physiology of the male bovine. R. P. Amann. XXII, 7

REPUBLICAN PARTY

The volume and stability of intraparty consensus in the House of Representatives during four recent Congresses. L. F. Anderson. XXII, 307

RESERPINE

Intermediates in the synthesis of reserpine. D. D. Rosenfeld. XXII, 78

RESINS see Gums and resins

RESONANCE

Theoretical and experimental analysis of networks of resonators and their application to the production of sound by the vocal tract. V. F. Albert. XXII, 287

RESONATORS, ELECTRIC see Electric resonators

RESPIRATION

Studies on the inhibitor resistant respiration of the mycelium and particulate extracts from Myrothecium verrucaria. G. W. Kidder III. XXII, 40

RESTRICTED STOCK OPTIONS

Appraisal of stock options as an incentive device — a study of their use and abuse. E. Wallace. XXII, 119

RETAIL TRADE—PUNJAB

An analysis of tertiary activity and consumer movement: the spatial structure of Ludhiana and Jullundur Districts, Punjab, in terms of central functions and the range of a central good. R. C. Mayfield. XXII, 225

REVIVALS—U. S.

Revivalism in the German Reformed Church in America to 1850, with emphasis on the Eastern synod. J. B. Frantz. XXII, 238

RHEOLOGY

The static and dynamic phenomenological macrorheology of cohesive soils. R. L. Kondner. XXII, 206

RHINITIS

Bordetella bronchiseptica induced porcine atrophic rhinitis. R. F. Cross. XXII, 233

RHODANATES see Thiocyanates

RHODIUM

A spectrophotometric determination of rhodium with s-diphenylcarbazone. Complexes of rhodium, tin, and chloride. F. L. Johnson, Jr. XXII, 46

RHODOSPIRILLUM GIGANTEUM see Rhodospirillum rubrum

RHODOSPIRILLUM GRACILE see Rhodospirillum rubrum

RHODOSPIRILLUM LONGUS see Rhodospirillum rubrum

RHODOSPIRILLUM PHOTOMETRICIUM see Rhodospirillum rubrum

RHODOSPIRILLUM RUBRUM

The metabolism of sulfate by the bacterial chromatophore. M. L. Ibanez. XXII, 29

RIVERS—POLLUTION see Water—Pollution

RIZAL Y ALONSO, JOSÉ, 1861-1898

Educacion, nacionalismo y propaganda en la literatura del Dr. José Rizal. [Spanish text]. J. F. Del-Pan. XXII, 257

ROAD ACCIDENTS see Traffic accidents

ROAD CONSTRUCTION WORKERS—MICHIGAN

Survey of industrial relations in leading Michigan road construction firms. G. J. Gore. XXII, 117

ROADS—BRAZIL

Routes over the Serra do Mar: an historical geography of transportation in the Rio de Janeiro-São Paulo Area, Brazil. R. P. Momsen, Jr. XXII, 226

ROCKS

Mechanism of rock failure under impact of a chisel-shaped bit. M. M. Singh. XXII, 217

ROCKS, ERUPTIVE see Rocks, Igneous

ROCKS, IGNEOUS

A study of the distribution of trace elements in some igneous rocks of northwestern and central Arizona. G. W. Putman. XXII, 230

ROLLING-MILLS—AUTOMATION

The use of magnetostriction to achieve fast adjustment of roll separation in multi-stand rolling mills. B. S. M. Granborg. XXII, 209

ROMAN DE THÈBES see Thèbes (Romance)

ROMAN LAW—MANUSCRIPTS

A lease of an olive grove from the archive of Aurelius Isidorus (P. Col., Inv. no. 65). S. B. Porges. XXII, 236

ROSENMAN, SAMUEL IRVING, 1896-

Samuel I. Rosenman: his public career. S. B. Hand. XXII, 234

ROSIN see Gums and resins

ROTATING DISKS see Disks, Rotating

RUBBER-SHEET GEOMETRY see Topology

RUBIDIUM IN SOILS see Soils—Rubidium content

RUMEN

Correlations between certain criteria of ruminant digestion in vivo and in vitro. D. M. Bowden. XXII, 1

RUMEN—BACTERIOLOGY

Study of cellulase from rumen bacteria and from Ruminococcus albus. J. M. Leatherwood. XXII, 53

RUMINOCOCCUS ALBUS

Study of cellulase from rumen bacteria and from Ruminococcus albus. J. M. Leatherwood. XXII, 53

RUSSIA—FOREIGN RELATIONS—FRANCE

French policy in Russia: 1755-1762. L. J. Oliva. XXII, 240

RUT see Estrus

SAFETY EDUCATION

The safety education program of the Philadelphia public schools — historical background, description, and evaluation. D. W. Kralovec. XXII, 140

SAFETY EDUCATION—LAW AND LEGISLATION —U. S.

A study of state laws and state education department regulations for safety education in the public schools of the United States. J. F. Nihan. XXII, 126

ST. THOMAS CHRISTIANS—HISTORY

The C. M. S. Mission of Help to the Syrian Church in Malabar, 1816-1840: a study in Protestant-Eastern Orthodox encounter. E. L. Ten Brink. XXII, 241

SALAMIS, BATTLE OF, 480 B. C.

Salamis and Plataea in the tradition of the Attic orators. F. W. Schlatter, S. J. XXII, 252

SALT

Effects of dietary sodium levels upon maternal responses of pyridoxine- and deoxypyridoxine-fed pregnant rats. A. Kirksey. XXII, 243

SALT SOLUTIONS see Solution (Chemistry)

SAND

The nitrogen fractionation of a clay treated sandy soil. J. Colom. XXII, 1

SAPPHIRES

Dislocations in single crystal sapphire as revealed by thermal etching. H. Palmour, III. XXII, 199

SARCOMA see Tumors

SAYINGS see Quotations

SCATTERING OF LIGHT see Light—Scattering

SCHEDULES, SCHOOL—MATHEMATICAL MODELS

Combinatorial scheduling: on finding a partition of a finite set which maximizes a set function. G. R. Sherman. XXII, 273

SCHISTOSOMA CATTOI see Schistosoma japonicum

SCHISTOSOMA JAPONICUM

Drug susceptibility of geographic strains of Schistosoma japonicum. K. Y. Chu. XXII, 232

SCHIZOPHRENIA

The effects of social reinforcing variables on the word recognition responses of schizophrenic and non-psychiatric patients. J. G. Rosenfeld. XXII, 326

The effects of two contradictory levels of reward and censure on schizophrenics. P. V. Ciotola. XXII, 320

The effects of verbal and non-verbal reinforcement on the performance of schizophrenic subjects. N. D. Koppenhaver. XXII, 323

Verbal conditioning in schizophrenia as a function of degree of social interaction. E. Ebner. XXII, 322

SCHOOL ADMINISTRATION see School management and organization

SCHOOL ADMINISTRATORS see School superintendents and principals

SCHOOL AND HOME see Home and school

SCHOOL BOARDS—U. S.

An analysis of appellate court decisions determining the authority of boards of education and their agents to establish rules and regulations governing the conduct of pupils, 1900 to 1960. N. L. Gamberoni. XXII, 136

SCHOOL CENTRALIZATION see Schools—Centralization

SCHOOL CHILDREN—TRANSPORTATION—PENNSYLVANIA

A proposed performance formula for the reimbursement of the school districts of Pennsylvania for expenditures for public school pupil transportation. R. E. Coleman. XXII, 132

SCHOOL CHILDREN—TRANSPORTATION—U. S. —STATES

Legislation affecting pupil transportation in the United States. J. G. Critchfield. XXII, 134

SCHOOL DISCIPLINE

The effects on non-target classmates of teachers' efforts to control deviant behavior. L. T. Ofchus. XXII, 165

SCHOOL EXCURSIONS

An evaluation of the field trip in the formation of social concepts and generalizations. E. C. Forster. XXII, 181

SCHOOL FUNDS see Public schools

SCHOOL FURNITURE see Schools—Furniture, equipment, etc.

SCHOOL INSPECTION see School management and organization

SCHOOL LAW see Educational law and legislation

SCHOOL LIFE see Students

SCHOOL MANAGEMENT AND ORGANIZATION

An analysis of authority and power in administration. J. M. Hanlon. XXII, 137

SCHOOL SCHEDULES see Schedules, School

SCHOOL SUPERINTENDENTS AND PRINCIPALS —CERTIFICATION—TENNESSEE

A study of certification standards in relation to the duties and responsibilities of the Tennessee high school principalship. F. L. Bass. XXII, 130

SCHOOL SUPERVISION, SECONDARY

A study of the department head in the comprehensive high school. B. J. Cook. XXII, 132

SCHOOL SUPPLIES see Schools—Furniture, equipment, etc.

SCHOOL TEACHING see Teaching

SCHOOL TRANSPORTATION see School children —Transportation

SCHOOL TRUSTEES see School boards

SCHOOLS—CENTRALIZATION

Observable changes in special services associated with unification. J. C. Packard, Jr. XXII, 141

SCHOOLS—FURNITURE, EQUIPMENT, ETC.

Warehousing in elementary schools. H. W. Colby. XXII, 131

SCHOOLS—INSPECTION see School management and organization

SCHOOLS—MANAGEMENT AND ORGANIZATION see School management and organization

SCHOOLS—SCHEDULES see Schedules, School

SCHOOLS, DENOMINATIONAL see Church schools

SCHOOLS, PAROCHIAL see Church schools

SCHOOLTEACHING see Teaching

SCIENCE—STUDY AND TEACHING—NEW JERSEY

Proposals for improvement of science teaching in New Jersey elementary schools. E. C. Richardson. XXII, 172

SCIENCE—STUDY AND TEACHING (ELEMENTARY)

Proposals for improvement of science teaching in New Jersey elementary schools. E. C. Richardson. XXII, 172

SCIENCE, MENTAL see Psychology

SCIENCE, SOCIAL see Sociology

SCIENCES, SOCIAL see Social sciences

SCIENTIFIC EDUCATION see Science—Study and teaching

SCIENTIFIC MANAGEMENT see Industrial management

SEA ANIMALS see Marine fauna

SECONDARY SCHOOLS see Public schools

SECURITY (PSYCHOLOGY)

Clothing values and their relation to general values and to social security and insecurity. M. Lapitsky. XXII, 244

SEEDLINGS

A study of the effect of temperature levels of germination environment on chemical and physical characteristics of cotton seedlings. M. N. Christiansen. XXII, 14

SEEDS—GERMINATION see Germination

SELECTIVE ABSORPTION see Absorption spectra

SELF

Distortions in the perception of self and others by persons using paranoid defenses. P. H. Havener. XXII, 322

Self-acceptance in relation to adjustment. D. C. Perry. XXII, 317

SELF-ASSURANCE see Self-reliance

SELF-EVALUATION

Self-evaluation and academic achievement. B. Borislow. XXII, 150

SELF-RELIANCE

A comparative study of self-perceptions of aggressive and withdrawn children. E. M. Morgan. XXII, 163

The effects of scholastic success and failure on the relationship among self-concept, ideal self, and level of aspiration. J. J. Freer. XXII, 347

A history of self-made manhood: the ideal of the self-made man in nineteenth century America. J. G. Cawelti. XXII, 254

SEMANTICS (PHILOSOPHY)

Foundations of acceptance. G. F. Rieman, Jr. XXII, 286

SEMEIOTIC see Semantics (Philosophy)

SEMICONDUCTORS

Galvanomagnetic properties of carriers associated with the cleaned germanium surface. R. A. Missman, Jr. XXII, 299

A microwave technique for the study of deviations from Ohm's law in high resistivity semiconductors. K. Rose. XXII, 213

SEMINARIANS

A comparative study of the interest and personality patterns of major seminarians. C. R. Sutter, C. PP. S. XXII, 328

A study of attitude changes in theological students during one year of seminary training. R. A. Proctor, Jr. XXII, 343

SEMIOTIC see Semantics (Philosophy)

SEROTONIN

The synthesis of some phenyl(2-hydroxy-3-pyrazyl)carbinols as possible antimetabolites of serotonin. V. S. Venturella. XXII, 85

SERPASIL see Reserpine

SERUM

A study on the effects of streptomycin on mammalian cells in culture and a study on the separation of growth promoting material for cell cultures from horse serum by dialysis. D. P. Metzgar, Jr. XXII, 36

SESQUIXANTHYDROL

Sesquixanthydrol and related compounds. R. G. Smith. XXII, 81

SEVEN YEARS' WAR, 1756-1763

French policy in Russia: 1755-1762. L. J. Oliva. XXII, 240

SEX HORMONES see Hormones, Sex

SHAW, GEORGE BERNARD, 1856-1950

An analytical study of the use of rhetorical devices in three selected plays of George Bernard Shaw: Saint Joan, Androcles and the Lion, and Candida. D. Dupler. XXII, 359

SHEDDING OF LEAVES see Defoliation

SHEEP—DISEASES

The effects of parenteral trypsin therapy for spinal cord hemisection in sheep. W. J. Tietz, Jr. XXII, 305

SHOCK WAVES

Interaction of a shock wave with a step boundary layer of high sound speed gas. J. L. Haslund. XXII, 288

SHORT STORIES, AMERICAN—HISTORY AND CRITICISM

Content analysis of middle class women's fiction from 1901 to 1960 as indicative of changing cultural values related to middle class birth-rates. E. V. Smith. XXII, 354

SIBERIA, WESTERN—INDUSTRIES

Industrial development in Western Siberia, a geographical analysis. R. E. Lonsdale. XXII, 225

SIDEREAL SYSTEM see Stars

SIGHT see Vision

SIGNIFICS see Semantics (Philosophy)

SILANE

Preparation and polymerization of certain diunsaturated silanes. R. W. Stackman. XXII, 82

SILESIAN WAR, 3d, 1756-1763 see Seven Years' War, 1756-1763

SILICANE see Silane

SILICIUM see Silicon

SILICO METHANE see Silane

SILICON—ISOTOPES

(d, p) and (d, t) reactions on the silicon isotopes. A. G. Blair. XXII, 291

SILURIAN PERIOD, LOWER see Geology, Stratigraphic—Ordovician

SILVER

Higher oxidation states of silver. M. Usategui. XXII, 63

SIZE OF FARMS see Farms, Size of

SKIN

The effect of chemically-defined media upon tissue cultures of skin, cystic disease and carcinomas from the human female breast. M. F. Orr. XXII, 24

Quantitative study of the effects of single doses of ultraviolet light on mouse skin. G. A. Soffen. XXII, 39

Studies on the proteolytic enzyme system of skin and its relationship to a state of hypersensitivity. J. Golubow. XXII, 51

SOCIAL CHANGE

A history of self-made manhood: the ideal of the self-made man in nineteenth century America. J. G. Cawelti. XXII, 254

SOCIAL INTERACTION

Verbal conditioning in schizophrenia as a function of degree of social interaction. E. Ebner. XXII, 322

SOCIAL MOBILITY

Religion and social mobility in industrial society. N. J. Weller. XXII, 354

SOCIAL PROBLEMS IN EDUCATION see Educational sociology

SOCIAL SCIENCE see Social sciences; Sociology

SOCIAL SCIENCES—STUDY AND TEACHING (SECONDARY)

The effectiveness of certain supervisory practices on pupil achievement in grades 7, 10, and 12 of the social studies classes of the Bald Eagle area schools. S. B. Willar. XXII, 185

SOCIAL STATUS

Status inconsistency: specification of a theory. R. Sokol. XXII, 352

SOCIAL STATUS—CASE STUDIES

Religious beliefs and social status: a study of the relationship between religious beliefs and social status levels in sixty-one churches of the Southern Appalachian Mountains. A. K. Jackson. XXII, 340

SOCIAL STUDIES see Social sciences

SOCIAL WELFARE see Charities

SOCIAL WORK AS A PROFESSION

A study of the diversity of role expectations of the position social worker: among professionally trained social workers in Syracuse, New York. J. Cohen. XXII, 350

SOCIAL WORKERS

Volunteer and staff participation in a voluntary social welfare association in the United States: a study of the National Young Women's Christian Association. A. C. Almanzor. XXII, 349

SOCIAL WORKERS—SYRACUSE, N. Y.

A study of the diversity of role expectations of the position social worker: among professionally trained social workers in Syracuse, New York. J. Cohen. XXII, 350

SOCIETY AND EDUCATION see Educational sociology

SOCIOLOGY

Ecology of Negro communities in Los Angeles County: 1940-1959. D. S. Williams. XXII, 356

SOCIOLOGY, EDUCATIONAL see Educational sociology

SODIUM

The preparation and electrical properties of some low content tungsten bronzes. W. McNeill. XXII, 60

SODIUM BOROHYDRIDE

Rates of reaction of cyclopropyl and phenyl substituted ketones with sodium borohydride: ketone reactivity as a model for carbonium ion stability. R. Bernheimer. XXII, 65

SODIUM CHLORIDE see Salt

SOIL COMPACTION see Soil stabilization

SOIL MECHANICS

The static and dynamic phenomenological macrorheology of cohesive soils. R. L. Kondner. XXII, 206

Stresses in soil masses under various boundary conditions. W. D. Finn. XXII, 205

SOIL MOISTURE

Available soil moisture as a stochastic process. D. E. Cooper. XXII, 268

Hydrologic balance of three soils supporting natural hardwoods, planted red pine, and old field plant communities in central Pennsylvania. W. R. Byrnes. XXII, 13

SOIL PHYSICS

Effects of rainfall energy on some physical properties of soils. K. M. Sor. XXII, 4

Physical impedance as a factor limiting plant growth and root penetration into compact subsoils. F. Y. Borden. XXII, 13

SOIL STABILIZATION

Dynamic stress transducers and the use of continuum mechanics in the study of various soil stress-strain relationships. W. L. Harris. XXII, 188

SOILS

Greenhouse studies on organic matter, phosphorus, soil compaction, and soil moisture as related to strawberry growth. W. B. Collins. XXII, 14

SOILS—NITROGEN CONTENT

The influence of different cropping schemes on the amino acid content, total nitrogen, and total organic carbon content of soil. U. C. Gupta. XXII, 3

The nitrogen fractionation of a clay treated sandy soil. J. Colom. XXII, 1

Nitrogen losses in gaseous form from different soils as affected by management. H. J. Fack. XXII, 2

A study of the mineralizable nitrogen fraction of selected North Carolina soils and its relation to crop responses to applied fertilizer nitrogen. C. D. Welch. XXII, 5

SOILS—POTASSIUM CONTENT

The uptake of potassium and rubidium-86 from the soil by corn roots. J. M. Walker. XXII, 5

SOILS—RUBIDIUM CONTENT

The uptake of potassium and rubidium-86 from the soil by corn roots. J. M. Walker. XXII, 5

SOILS—OREGON—MARION COUNTY

Techniques for characterizing Oregon soils for agricultural purposes in terms of physical and economic productivities. S. C. James. XXII, 112

SOILS (ENGINEERING) see Soil mechanics

SOLUBILITY

Solubility of xenon in liquid metals. C. Mitra. XXII, 100

SOLUBLE FERMENTS see Enzymes

SOLUTION (CHEMISTRY)

Thermodynamic properties of high temperature aqueous solutions. C. M. Criss. XXII, 89

SOLVENTS

Dimethylsulfoxide as a solvent in coordination chemistry. D. K. Straub. XXII, 61

Thermochemical precipitation titrimetry and precipitation thermodynamics in aqueous solutions and molten salts. E. J. Billingham, Jr. XXII, 44

SOLVOLYSIS

Solvolysis kinetics of pyridine-boranes. E. R. Birnbaum. XXII, 58

SORPTION OF GASES see Gases—Absorption and adsorption

SOUND—MEASUREMENT

Experimental studies of propagation distortion of finite amplitude noise. F. Oda. XXII, 288

SOUND-WAVES

Experimental studies of propagation distortion of finite amplitude noise. F. Oda. XXII, 288

SOUTHERN APPALACHIAN MOUNTAINS see Appalachian Mountains, Southern

SOY-BEAN

The effects of herbicidal chemicals on the activity of terminal oxidase enzymes in plant tissues. K. L. Hill. XXII, 303

Influence of nitrogen and phosphorus fertilizers on the morphology and physiology of soybean roots. S. R. Wilkinson. XXII, 6

SPACE FRAMES see Structural frames

SPACE LATTICE (MATHEMATICS) see Lattice theory

SPACE-PERCEPTION

The effects of group counseling in a controlled workshop setting on attitude, manual dexterity and ability to perceive correct spatial relations. M. Waldman. XXII, 328

SPANISH FICTION—19th CENTURY—HISTORY AND CRITICISM

The aristocrat in the Spanish novel of the naturalistic period. H. E. Lewald. XXII, 262

SPANISH TREFOIL see Alfalfa

SPEAKERS see Orators

SPEAKERS (RECITATION BOOKS) see Readers and speakers

SPECIE see Silver

SPECIFIC HEAT

The heat capacity of several superconductors and other solids at very low temperatures. C. A. Bryant, Jr. XXII, 297

SPECTROPHOTOMETER

A spectrophotometric determination of rhodium with s-diphenylcarbazone. Complexes of rhodium, tin, and chloride. F. L. Johnson, Jr. XXII, 46

Spectrophotometric estimation of metmyoglobin in frozen meat extracts. J. P. Lane. XXII, 221

SPECTRUM, INFRA-RED

Rotational isomerism of unbranched 1-alkenes by infrared spectra. L. A. Harrah. XXII, 93

SPEECH

Theoretical and experimental analysis of networks of resonators and their application to the production of sound by the vocal tract. V. F. Albert. XXII, 287

SPEECH—STUDY AND TEACHING

A historical study of speech education at the University of Southern California (1880 through 1950). E. W. Priddy. XXII, 361

SPEECH, DISORDERS OF

Differences between children who spontaneously outgrew and children who retained functional articulation errors. S. Dickson. XXII, 151

Some factors in the efficacy of training mothers of slow learning and normal children with functional articulation problems. R. K. Sommers. XXII, 362

SPINAL CORD—SURGERY

The effects of parenteral trypsin therapy for spinal cord hemisection in sheep. W. J. Tietz, Jr. XXII, 305

SPIRILLUM RUBRUM see Rhodospirillum rubrum

SPRINKLER IRRIGATION

A theoretical analysis of the decay of secondary flow following a pipe bend. C. C. Shih. XXII, 189

SPUN GLASS see Glass fibers

SQUARES, LEAST see Least squares

SQUASH—DISEASES AND PESTS

Seed and pollen transmission of cherry ring spot virus in buttercup squash. C. Das. XXII, 20

STABILITY

A contribution to photoelastic structural stability analysis. W. L. Bingham. XXII, 216

STABILIZATION OF SOILS see Soil stabilization

STAGE see Theater

STARS—RADIATION

Energy loss mechanisms from very dense stars. R. C. Stabler. XXII, 295

STATESMEN

Personality and politics: a qualitative analysis of the basic factors of political success. S. Ebbin. XXII, 309

STATISTICAL DECISION

A theory of adjusting parameter-estimates in decision models. S. K. Gupta. XXII, 269

STATUS, SOCIAL see Social status

STEAM

Heat transfer to a mist flow. J. D. Parker. XXII, 214

STECLIN see Tetracycline

STEEL

Strain aging effects in SAE 1018 steel & arc-cast molybdenum. G. W. Brock. XXII, 216

STEEL INDUSTRY AND TRADE—U. S.

Industrial agglomeration theory and the agglomerative impact of basic steel mills — two case studies. B. B. Christopher. XXII, 106

STEREOCHEMISTRY

The stereochemistry of some reactions in a bridged polycyclic system. The stereochemistry of solvent-cage reactions. W. C. Firth, Jr. XXII, 70

Stereochemistry of the Diels-Alder reaction. J. G. Martin. XXII, 74

STEVENS, THADDEUS, 1792-1868

The congressional speaking of Thaddeus Stevens. R. W. Tyson. XXII, 363

STILLS see Distillation

STOCK OPTIONS, RESTRICTED see Restricted stock options

STOICHIOMETRY see Chemistry, Physical and theoretical

STONE-CUTTING

Mechanism of rock failure under impact of a chisel-shaped bit. M. M. Singh. XXII, 217

STORIES see Short stories

STRAINS AND STRESSES

Interpretation and measurement of strains in wood. J. N. Walker. XXII, 189

Mechanism of rock failure under impact of a chisel-shaped bit. M. M. Singh. XXII, 217

STRATIGRAPHIC GEOLOGY see Geology, Stratigraphic

STRAWBERRIES

Factors affecting uptake and movement of certain substances in the strawberry plant. R. Garren, Jr. XXII, 15

Greenhouse studies on organic matter, phosphorus, soil compaction, and soil moisture as related to strawberry growth. W. B. Collins. XXII, 14

STREAM POLLUTION see Water—Pollution

STREET TRAFFIC see City traffic

STREETS

Evaluation of major urban intersections. W. W. Schenler. XXII, 207

STREPTOMYCIN

The microbiological degradation of streptomycin. D. Klein. XXII, 30

A study on the effects of streptomycin on mammalian cells in culture and a study on the separation of growth promoting material for cell cultures from horse serum by dialysis. D. P. Metzgar, Jr. XXII, 36

STRESS (PHYSIOLOGY)

The effects of epinephrine, chlorpromazine, and dibenzyline upon the fright responses of rats under stress and non-stress conditions. J. E. Singer. XXII, 318

STRESSES see Strains and stresses

STRUCTURAL ANALYSIS (MATHEMATICS) see Lattice theory

STRUCTURAL ENGINEERING see Strains and stresses; Structures, Theory of

STRUCTURAL FRAMES

Stability of elastic and partially plastic frames. L.-W. Lu. XXII, 206

STRUCTURAL GEOLOGY see Geology, Structural

STRUCTURES, THEORY OF

A study of structural proportioning utilizing the concept of a limiting probability of failure of the total structure. G. E. Ingram. XXII, 205

STUDENT LIFE AND CUSTOMS see Students

STUDENT TEACHING

A critical analysis of selected research on student teaching in undergraduate teacher training institutions in the United States, 1929-1959. W. M. Young. XXII, 176

A survey of the professional practicum course of the state colleges of the Commonwealth of Pennsylvania. J. D. Lawson. XXII, 171

STUDENTS—MICHIGAN

Survey of freshman orientation programs in the six publicly supported universities in Michigan and including a review of the development of student personnel services in American higher education with emphasis on freshman orientation. N. B. M. Daisher. XXII, 134

STUDENTS—MISSOURI

The occupational and geographical distribution of small town Missouri high school students: a pilot study. J. T. Howard. XXII, 351

SUBSTITUTIONS see Groups, Theory of

SUCCESS

The effects of scholastic success and failure on the relationship among self-concept, ideal self, and level of aspiration. J. J. Freer. XXII, 347

SUDAN GRASS

Sudangrass and pearl millet development and productivity as influenced by cutting heights. D. A. Mays. XXII, 17

SUGAR-CANE

Evaluation of commercial deliveries of sugar cane. B. B. Paul. XXII, 200

SULPHOCYANATES see Thiocyanates

SULPHOCYANIDES see Thiocyanates

SULPHONES

Reactions of certain Grignard reagents of sulfones and disulfones. E. T. Boyd. XXII, 67

SULPHUR

The sulphur distribution of papain and related studies. A. N. Glazer. XXII, 50

SULPHUR—ISOTOPES

Isotopic geochemistry of sulphur. W. U. Ault. XXII, 227

SULPHUR METABOLISM

The metabolism of sulfate by the bacterial chromatophore. M. L. Ibanez. XXII, 29

SULPHUR ORGANIC COMPOUNDS

Three studies in the oxidation of organic sulfur compounds. L. S. Levitt. XXII, 73

SULPHURIC ACID

Reaction of bituminous coal with concentrated sulfuric acid. M. P. Thomas. XXII, 202

SULPHUROUS ACID

Evaluation of sulphurous acid as a leaching agent for oxidized low grade nickel ores. L. P. Lenas. XXII, 197

SUPERCONDUCTIVITY

The heat capacity of several superconductors and other solids at very low temperatures. C. A. Bryant, Jr. XXII, 297

SUPERINTENDENTS OF SCHOOLS see School superintendents and principals

SUPERSONIC AERODYNAMICS see Aerodynamics, Supersonic

SUPERVISION OF EMPLOYEES

Supervisor perception of subordinate attitudes. T. H. Jerdee. XXII, 334

SURFACES

Behavior of curves and surfaces through fundamental elements of birational transformations. E. F. Myers. XXII, 271

An involution of period seventeen. J. W. Kenelly, Jr. XXII, 270

SURFACES, CURVES ON see Curves on surfaces

SWEET CORN see Maize

SWEET POTATOES—DISEASES AND PESTS

Some physiological comparisons of the fusarium surface rot and fusarium wilt pathogens of sweet potato. K. D. Fisher. XXII, 21

SWEET POTATOES—VARIETIES

The reaction of several varieties of sweet potatoes to five species of root-knot nematodes (Meloidogyne spp.). M. J. Giamalva. XXII, 21

SWINE—MISSOURI

An analysis of changes in structure of hog markets in northeast Missouri. C. L. Cramer, Jr. XXII, 110

SWINE—SOUTHERN STATES

A study of hog movements and inter-area price relations in the Southeast. R. G. Stout. XXII, 114

SWITCHING THEORY

On "Bang-Bang" adaptive control systems. R. E. Kopp. XXII, 210

SYLVICULTURE see Forests and forestry

SYMBOLIC AND MATHEMATICAL LOGIC see Logic, Symbolic and mathematical

SYMPHONIES—SCORES

Symphony no. 1. R. A. McDuffie, Jr. XXII, 281

Symphony no. 2, opus no. 25. F. Mueller. XXII, 282

SYNTACTICS see Semantics (Philosophy)

SYNTHETIC CHEMISTRY see Chemistry, Organic —Synthesis

TADPOLES see Frogs

TALL FESCUE

Correlations between certain criteria of ruminant digestion in vivo and in vitro. D. M. Bowden. XXII, 1

TAXATION—U. S.

The Internal revenue act of 1954: policy and politics. E. N. Feingold. XXII, 310

TAXATION OF INCOME see Income tax

TEACHERS

The development of a scale for motive assessment: achievement and affiliation. B. R. VanZandt. XXII, 175

TEACHERS—MISSOURI

A description and comparison of selected characteristics and qualifications possessed by full-time, public school, classroom teachers and the new teachers employed in Missouri during the 1958-59 school year. D. M. Van Devander. XXII, 130

TEACHERS—U. S.—SALARIES, PENSIONS, ETC.

An analysis of the fringe benefit programs of seven large corporations and seven large school systems. W. H. Kanzler. XXII, 139

TEACHERS, TRAINING OF

The learner in teacher education: a study of selected aspects of values. B. R. Joyce. XXII, 170

Teachers in the becoming: a case study of an initial professional experience for prospective elementary school teachers. A. T. Allen. XXII, 169

A team approach to theory and practice in early childhood teacher education. M. R. Sabath. XXII, 174

TEACHERS, TRAINING OF—KANSAS

A study of the development of the special education program in Kansas, and an evaluation, with emphasis on the professional preparation of special education personnel. J. J. Eisenbach. XXII, 122

TEACHERS AND PARENTS see Home and school

TEACHING

The construction and validation of a test of ten teacher skills used in reading instruction, grades 2-5. E. W. Wade. XXII, 167

TECHNOLOGICAL INNOVATIONS

The employment of labor and the cost of capital in manufacturing industries as they are related to wage changes and technological progress. R. I. McKinnon. XXII, 120

TECTONICS (GEOLOGY) see Geology, Structural

TEKTITE

Phase-equilibrium studies on tektite and meteorite systems. W. A. Cassidy. XXII, 277

TELEVISION IN EDUCATION

A critical analysis of attitudes of selected elementary students toward television teaching in the Detroit television teaching project. D. V. Silagyi. XXII, 128

TEMPERATURE—PHYSIOLOGICAL EFFECT

Effect of temperature on spontaneous and induced activity of arthropod nervous tissues. P. M. BeMiller. XXII, 33

Low temperature tolerance of insects in relation to the influence of temperature on muscle apyrase activity. J. A. Mutchmor. XXII, 304

TEMPERATURE, ANIMAL AND HUMAN see Body temperature

TEMPERATURE CURVE see Body temperature

TEMPERATURES, LOW see Low temperatures

TERTIARY PERIOD see Geology, Stratigraphic —Tertiary

TESTS, MENTAL see Mental tests

TETRABORANE

The oxidation of tetraborane. K. H. Ludlum. XXII, 97

TETRACYCLINE

Part I: Synthetic approaches to tetracyclines. Part II: Mechanism of the reaction of carbonyl cyanide with olefins. Part III: Alkylation of dienamines. G. I. Birnbaum. XXII, 65

TETRAHYMENA PYRIFORMIS

Effects of caffeine on the physiology and chromosome behavior of the ciliate, Tetrahymena pyriformis. J. D. Eisen. XXII, 302

THACKERAY, WILLIAM MAKEPEACE, 1811-1863

Dickens and Thackeray: the reciprocal influences. E. E. Irwin. XXII, 247

THEATER—LEXINGTON, KY.

The history of the Lexington theatre from the beginning to 1860. (Volumes I and II). M. I. T. Crum. XXII, 245

THEATER—PORTLAND, OR.

The history of the theatre in Portland, Oregon, 1846-1959. L. L. Schilling, Jr. XXII, 361

THÈBES (ROMANCE)

A critical edition of the Roman de Thèbes (lines 1-5394), with an introduction, notes, and glossary. D. P. Ripley. XXII, 264

THEOLOGICAL EDUCATION see Religious education

THEOLOGY, CRISIS see Dialectical theology

THEOLOGY, ECCLESIASTICAL see Church

THEORETICAL CHEMISTRY see Chemistry, Physical and theoretical

THEORY OF GAMES see Game theory

THEORY OF GROUPS see Groups, Theory of

THEORY OF STRUCTURES see Structures, Theory of

THERMAL BARRIER see Aerodynamic heating

THERMAL EQUILIBRIUM see Heat; Thermodynamics

THERMAL ETCHING

Dislocations in single crystal sapphire as revealed by thermal etching. H. Palmour, III. XXII, 199

THERMAL PROPERTIES OF MATERIALS see Zinc—Thermal properties

THERMO-AERODYNAMICS see Aerodynamic heating

THERMOCHEMISTRY

The thermal decomposition and hydrogenation of diboron tetrachloride and diboron tetrafluoride. J. B. Barr. XXII, 86

THERMODYNAMICS

Heats of formation of coordination compounds. H. Kido. XXII, 94

Thermodynamic properties of high temperature aqueous solutions. C. M. Criss. XXII, 89

THIETANE

The synthesis and reactions of derivatives of thietane and thietene. M. E. Christy. XXII, 69

THIETENE

The synthesis and reactions of derivatives of thietane and thietene. M. E. Christy. XXII, 69

THIOCYANATES

A study of the oxidation of thiocyanate by acidic nitrite and nitrate solutions. W. A. Biggart II. XXII, 87

THIOCYANIDES see Thiocyanates

THIOPHENE

Synthesis of hydrocarbons from thiophene derivatives. I. J. Spilners. XXII, 81

THOMAS CHRISTIANS see St. Thomas Christians

THORAZINE see Chlorpromazine

THOREAU, HENRY DAVID, 1817-1862. WALDEN

An annotated edition of Henry David Thoreau's Walden. D. G. Rohman. XXII, 249

THOROUGHFARES see Roads; Streets

THYRO-ARYTENOID LIGAMENTS see Vocal cords

THYROID GLAND

The influence of hypothyroidism and chorionic gonadotrophin on ovarian and adrenal ascorbic acid in the rat. R. P. Blye. XXII, 364

Methods of determining thyroid secretion rates in dairy cattle. T. B. Post. XXII, 305

THYROXINE

Methods of determining thyroid secretion rates in dairy cattle. T. B. Post. XXII, 305

TILNEY, EDMUND, d. 1610. THE FLOWER OF FRIENDSHIPPE

A critical 3rd edition of Edmund Tilney's The flower of friendshippe, published in 1577, edited, with introduction, notes, and glossary. R. G. Johnson. XXII, 247

TIMBER—TESTING see Wood—Testing

TIN

A spectrophotometric determination of rhodium with s-diphenylcarbazone. Complexes of rhodium, tin, and chloride. F. L. Johnson, Jr. XXII, 46

TISSUE CULTURE

Conditions for the culture of arthropod tissues. J. A. P. Haskell. XXII, 367

The effect of chemically-defined media upon tissue cultures of skin, cystic disease and carcinomas from the human female breast. M. F. Orr. XXII, 24

TOBACCO MANUFACTURE AND TRADE

A systems analysis of the harvesting, curing, and marketing stages of flue-cured tobacco production. L. U. Cockroft. XXII, 110

TONALITY

Tonality. M. M. Gustin. XXII, 281

TOPOLOGY

On S-spaces and the open mapping theorem. T. Husain. XXII, 269

TORSION

Torsional stiffness of non-uniformly heated cantilever plates for any aspect ratio and initial twist. D. W. Breuer. XXII, 187

TOWN PLANNING see Cities and towns—Planning

TOWNSHIP FINANCE see Local finance

TOXALBUMINS see Albumin

TRACE ELEMENTS

A study of the distribution of trace elements in some igneous rocks of northwestern and central Arizona. G. W. Putman. XXII, 230

TRADE BARRIERS see Commercial policy

TRADE-UNIONS—GERMANY (FEDERAL REPUBLIC, 1949-)

Codetermination and the West German trade unions. G. R. Crossman. XXII, 308

TRAFFIC, CITY see City traffic

TRAFFIC ACCIDENTS

Personality differences and similarities between offender and non-offender Air Force motor vehicle operators. W. J. Hubert. XXII, 156

TRAFFIC VIOLATIONS

Personality differences and similarities between offender and non-offender Air Force motor vehicle operators. W. J. Hubert. XXII, 156

TRAINING, PHYSICAL see Physical education and training

TRAINING OF CHILDREN see Children—Management

TRANSAMINASE

The effect of altered endocrine states on the properties of hepatic glutamic-pyruvic transaminase. D. S. Beattie. XXII, 47

TRANSFER OF LEARNING see Transfer of training

TRANSFER OF TRAINING

An experiment to determine the effect of learning conversational French on academic achievement of third grade children: an investigation to determine whether instruction in conversational French in third grade classes in suburban and metropolitan New York schools will affect achievement in reading, arithmetic, spelling, and language. E. W. Lopato. XXII, 160

TRANSFER STUDENTS

A study of personnel data as predictors of behavior of transfer students at the University of Colorado. R. L. Nash. XXII, 164

TRANSFORMATIONS (MATHEMATICS)

Behavior of curves and surfaces through fundamental elements of birational transformations. E. F. Myers. XXII, 271

Extensions and applications of the method of finite transforms. S. Kaplan. XXII, 214

TRANSFORMATIONS, QUADRATIC

An involution of period seventeen. J. W. Kenelly, Jr. XXII, 270

TRANSKETOLASE

The mechanism of action of transketolase. J. L. Rhoades. XXII, 55

TRANSMISSION OF HEAT see Heat—Transmission

TRANSPLANTATION OF ORGANS, TISSUES, ETC.

Investigations associated with the transplantation of bovine ova. T. L. Avery. XXII, 302

TRANSPORTATION—BRAZIL—HISTORY

Routes over the Serra do Mar: an historical geography of transportation in the Rio de Janeiro-São Paulo Area, Brazil. R. P. Momsen, Jr. XXII, 226

TRANSPORTATION OF SCHOOL CHILDREN see School children—Transportation

TRIANGULATION

Proposal, development, and testing of a system of analytical triangulation for medium-scale digital computers. W. C. Mahoney. XXII, 230

TRICHOSPORON

A comparative study of some endocellular proteolytic enzymes of an oxidative type yeast. R. L. Maginnis. XXII, 31

TRIPHENYLTIN HYDRIDE

The reaction of triphenyltin hydride with the acetylenic bond. N. V. Kern. XXII, 73

TRYPSASE see Trypsin

TRYPSIN

The effects of parenteral trypsin therapy for spinal cord hemisection in sheep. W. J. Tietz, Jr. XXII, 305

TUBERCULOSIS IN ANIMALS

Influence of dietary protein on liver constituents of tuberculous and non-tuberculous guinea pigs. R. E. Bleiler. XXII, 242

TUBES—FLUID DYNAMICS

Transport processes in two-phase turbulent flow. C.-L. Tien. XXII, 215

TUMORS

The distribution of S^{35} from labeled methionine among the plasma proteins of tumor-bearing and protein-depleted dogs. T. J. Russell, Jr. XXII, 55

TUNGSTEN—DEFECTS

Bombardment of tungsten with 20 kev helium atoms in a field ion microscope. M. K. Sinha. XXII, 300

TUNGSTEN BRONZE

The preparation and electrical properties of some low content tungsten bronzes. W. McNeill. XXII, 60

TURBULENCE

A study of the structure of turbulent shear flow in pipes. W. A. Brookshire. XXII, 192

Transport processes in two-phase turbulent flow. C.-L. Tien. XXII, 215

ULTRA-VIOLET RAYS—PHYSIOLOGICAL EFFECT

Quantitative study of the effects of single doses of ultraviolet light on mouse skin. G. A. Soffen. XXII, 39

UNGRADED SCHOOLS see Ability grouping in education

UNIFIED SCIENCE see Semantics (Philosophy)

UNIONS, TRADE see Trade-unions

UNITED STATES—CITY PLANNING see Cities and towns—Planning—U. S.

UNITED STATES—GOVERNMENT see United States—Politics and government

UNITED STATES—HISTORY, POLITICAL see United States—Politics and government

UNITED STATES—INDUSTRIES

Planning for industrial development: with emphasis on the metropolitan area. C. J. Wingfield. XXII, 316

UNITED STATES—POLITICS AND GOVERNMENT—1857-1861

Civil War issues in Philadelphia, 1856-1865. W. W. Dusinberre. XXII, 237

UNITED STATES—POLITICS AND GOVERNMENT—CIVIL WAR

Civil War issues in Philadelphia, 1856-1865. W. W. Dusinberre. XXII, 237

UNITED STATES—POPULATION

Content analysis of middle class women's fiction from 1901 to 1960 as indicative of changing cultural values related to middle class birthrates. E. V. Smith. XXII, 354

UNITED STATES—RACE QUESTION—CASE STUDIES

Friendship formation in two adjacent interracial housing projects. D. S. Claster. XXII, 346

UNITED STATES—RELIGION

A factorial analysis of clergymen's ratings of concepts regarding what it means to be "religious". [A monograph]. XXII, 371

UNITED STATES—REVENUE see Taxation—U. S.

U. S. AIR FORCE—TRANSPORTATION

Personality differences and similarities between offender and non-offender Air Force motor vehicle operators. W. J. Hubert. XXII, 156

U. S. CONGRESS. HOUSE—VOTING

The volume and stability of intraparty consensus in the House of Representatives during four recent Congresses. L. F. Anderson. XXII, 307

U. S. LAWS, STATUTES, ETC. INTERNAL REVENUE CODE

The Internal revenue act of 1954: policy and politics. E. N. Feingold. XXII, 310

URANIUM

Preparation and structural properties of some fluorometallates of uranium and group V metals. A. E. Baker. XXII, 58

A study of the incorporation of uranium by synthesized crystals of lead sulfide. J. J. Hutta. XXII, 278

URBAN PLANNING see Cities and towns—Planning

URBAN TRAFFIC see City traffic

UTERUS

Effect of female sex hormones (estrogen and progesterone), thyroid gland (thyroxine) and vitamin B_{12} on the uterus. M. S. Fahim. XXII, 8

UTILITY THEORY

An analysis of the application of utility theory to the development of two-stage testing models. J. H. Rosenbach. XXII, 165

VASCULAR PLANTS see Botany

VEGETABLE KINGDOM see Botany; Plants

VEGETABLE MOLD see Soils

VELOCITY OF CHEMICAL REACTION see Chemical reaction, Rate of

VERTICILLIUM ALBO-ATRUM

Studies on the cellular composition and germination of microsclerotia of Verticillium albo-atrum R&B. T. R. Pyke. XXII, 38

VIBRATION

Vibration analysis of continuous beam-columns with uniformly distributed axial load. E. H. McKinney. XXII, 270

VIRUS DISEASES OF PLANTS

Seed and pollen transmission of cherry ring spot virus in buttercup squash. C. Das. XXII, 20

VIRUSES

Host cell-virus interactions in cultures of mammalian cells infected with Japanese encephalitis virus. D. R. M. Dubbs. XXII, 27

VISION

Foveal flicker-fusion frequency for interrupted light superposed on steady light. A. Hyman. XXII, 333

The relationship between a test of visual sensitivity and judged qualities of children's drawings. F. Bedogne, Jr. XXII, 149

Visual target location as a function of number and kind of competing signals. D. M. Promisel. XXII, 336

VITAMINS

The biosynthesis of the corrin moiety of vitamin B_{12} from methionine and δ-aminolevulinic acid. R. C. Bray. XXII, 48

VOCABULARY TESTS

The multiple-meaning synonym vocabulary test for children of elementary school age. A. A. Angeloni. XXII, 148

VOCAL CORDS

Theoretical and experimental analysis of networks of resonators and their application to the production of sound by the vocal tract. V. F. Albert. XXII, 287

VOCATIONAL EDUCATION

Characteristic differences of trade school students and their bearing on post-school occupational plans. B. W. Brown. XXII, 178

A factorial analysis of the "basic" interest patterns of two hundred women college students in various curricular groups. A. C. Montague. XXII, 324

VOTING—ITALY

The influence of socio-economic factors on party vote in the Italian general election of June 7, 1953. S. A. Watts, Jr. XXII, 311

WAGES

The employment of labor and the cost of capital in manufacturing industries as they are related to wage changes and technological progress. R. I. McKinnon. XXII, 120

WAGES—U. S.

Wage and non-wage shares in business product, 1899-1929. A. I. Grant. XXII, 107

WAITING-LINE THEORY see Queuing theory

WALTON, IZAAK, 1593-1683. THE LIFE OF SIR HENRY WOTTON

Izaak Walton's Life of Sir Henry Wotton, 1651, 1654, 1670, 1672, 1675; a study of sources, revisions, and chronology. R. E. Fehner. XXII, 246

WAR—MORAL ASPECTS see War and religion

WAR AND CHRISTIANITY see War and religion

WAR AND RELIGION

John Wesley's attitude toward war; a study of the historical formation, the theological determination, and the practical manifestation of John Wesley's attitude toward war and its place in Methodism. E. W. Gerdes. XXII, 338

WATER—FLOW see Hydraulics

WATER—POLLUTION—CLARION RIVER

The composition of fish communities in relation to river pollution. D. G. Bardarik. XXII, 364

WATER—POLLUTION—TIONESTA CREEK

The composition of fish communities in relation to river pollution. D. G. Bardarik. XXII, 364

WATER-COOLED REACTORS see Pressurized water reactors

WATER RESOURCES DEVELOPMENT—DELAWARE VALLEY

Citizen group activity in the Delaware River Basin. D. J. Pugliese. XXII, 316

WATER-SUPPLY ENGINEERING

Joint operation of gravity reservoirs and pumped supplies. M. J. Willis. XXII, 219

WAVE FILTERS, ELECTRIC see Electric filters

WAVE MECHANICS

Velocity-dependent nuclear forces. M. M. Razavy. XXII, 294

WAYNE STATE UNIVERSITY, DETROIT—STUDENTS

The learner in teacher education: a study of selected aspects of values. B. R. Joyce. XXII, 170

WEEDICIDES see Herbicides

WELFARE WORK see Charities

WESLEY, JOHN, 1703-1791

John Wesley's attitude toward war: a study of the historical formation, the theological determination, and the practical manifestation of John Wesley's attitude toward war and its place in Methodism. E. W. Gerdes. XXII, 338

WESTERN SIBERIA see Siberia, Western

THE WESTMINSTER REVIEW

The Westminster review, 1824-1857: with special emphasis on literary attitudes. R. T. Van Arsdel. XXII, 251

WHEAT

Environmental factors influencing node bending of soft red winter wheat. M. J. Johnson. XXII, 4

WHITE COLLAR WORKERS see Clerks

WHOLESALE TRADE—U. S.

Dynamics of wholesale trading areas. J. L. Goldstucker. XXII, 116

WINCHESTER, MASS.—SOCIAL CONDITIONS

Status inconsistency: specification of a theory. R. Sokol. XXII, 352

WIVES

A study of role consensus in the family system. A. Yourglich. XXII, 355

WOLFRAMIUM see Tungsten

WOMAN

A factorial analysis of the "basic" interest patterns of two hundred women college students in various curricular groups. A. C. Montague. XXII, 324

Some environmental influences on food habits of women clerical workers. A. J. Bricker. XXII, 242

WOMAN—DRESS see Clothing and dress

WOMAN—PHYSICAL EDUCATION see Physical education for women

WOMB see Uterus

WOOD—TESTING

Interpretation and measurement of strains in wood. J. N. Walker. XXII, 189

WOOD-ALCOHOL

A study of the kinetics of the reactions of the chloropyridines and the chloropyridine N-oxides with sodium methoxide in methanol. R. J. Boxer. XXII, 66

WORK EXPERIENCE see Apprentices; Vocational education

WORKING-MEN'S ASSOCIATIONS see Trade-unions

WORLD ECONOMICS see Commercial policy

WORLD LITERATURE see Literature

WORLD NEWS see Foreign news

XENON

Solubility of xenon in liquid metals. C. Mitra. XXII, 100

YOUNG WOMEN'S CHRISTIAN ASSOCIATIONS

Volunteer and staff participation in a voluntary social welfare association in the United States: a study of the National Young Women's Christian Association. A. C. Almanzor. XXII, 349

YOUNG'S MODULUS see Elasticity

ZINC—ELECTRIC PROPERTIES

Experimental determination of the thermal conductivity and Peltier tensors in a single crystal of zinc at liquid helium temperature. N. H. Zebouni. XXII, 301

ZINC—THERMAL PROPERTIES

Experimental determination of the thermal conductivity and Peltier tensors in a single crystal of zinc at liquid helium temperature. N. H. Zebouni. XXII, 301

ZIRCONIUM

A study of the effect of certain rare earth elements on the alpha-beta transformation of zirconium. L. C. Ianniello. XXII, 217

ZIRCONIUM ALLOYS

A study of the effect of certain rare earth elements on the alpha-beta transformation of zirconium. L. C. Ianniello. XXII, 217

ABU ELNASR, Abd ELmonim. XXII, 345
ACHESON, Willard Phillips. XXII, 267
AHEARN, George Patrick. XXII, 63
ALBERT, Vernon F. XXII, 287
ALLEN, Arthur Thomas. XXII, 169
ALLISTON, Charles Walter. XXII, 301
ALMANZOR, Angelina Carunuñgan. XXII, 349
ALPER, Allen M. XXII, 227
AMANN, Rupert Preynoessl. XXII, 7
ANDERSON, Frederic John. XXII, 147
ANDERSON, Lee Franklin. XXII, 307
ANGELONI, Anthony Alfred. XXII, 148
ANNIS, Eleanor Audrey. XXII, 176
ANNIS, William Henry. XXII, 121
ARANGO, Ergasto Ramón. XXII, 307
ARMINGTON, Alton Fearing. XXII, 190
ARMSTRONG, DeWitt Clinton, III. XXII, 313
ARMSTRONG, James Calvin. XXII, 290
ATTANASIO, Frederick Gerard. XXII, 357
AUERBACH, Arnold J. XXII, 349
AULT, Wayne U. XXII, 227
AUSTIN, Leonard George. XXII, 191
AVERY, Thomas Lee. XXII, 302
BABA, Paul David. XXII, 296
BAKER, Ann Eldora. XXII, 58
BANDY, Anastasius Constantine. XXII, 251
BANILOWER, Howard. XXII, 267
BARANY, James Walter. XXII, 186
BARDARIK, Daniel George. XXII, 364
BARNES, Edwin Ellsworth. XXII, 86
BARNES, Henry William. XXII, 329
BARR, John Baldwin. XXII, 86
BARTH, George William. XXII, 149
BARTZ, Kenneth William. XXII, 63
BASS, Floyd Lester. XXII, 130
BATTERSHELL, Robert Dean. XXII, 64
BAYLEN, Joseph O. XXII, 32
BAYOUMI, Mohamed Ashraf el- see El-Bayoumi, Mohamed Ashraf.
BEAMES, Calvin Greenwood, Jr. XXII, 364
BEATTIE, Diana Scott. XXII, 47
BEDOGNE, Frank, Jr. XXII, 149
BeMILLER, Paraskevi Mavridis. XXII, 33
BENSON, Harold N. XXII, 7
BENTZ, Robert Paul. XXII, 109
BERKHOFER, Robert Frederick, Jr. XXII, 25
BERNHEIMER, Ralph. XXII, 65
BERNSTEIN, Hyman. XXII, 290
BICKNELL, Joan Colleen Patton. XXII, 279
BIERLY, James Nieman, Jr. XXII, 296
BIGGART, Waddell Alexander, II. XXII, 87
BILLINGHAM, Edward John, Jr. XXII, 44
BINGHAM, Amelia B. XXII, 177
BINGHAM, William Louis. XXII, 216
BIRNBAUM, Ernest Rodman. XXII, 58
BIRNBAUM, George Ignatz. XXII, 65
BLAIR, Allen Guyan. XXII, 291
BLEILER, Roberta Ellen. XXII, 242
BLUESTONE, Sydney. XXII, 87
BLYE, Richard Perry. XXII, 365
BOCK, Robert Howard. XXII, 115
BOLLE, Donald Martin. XXII, 208
BORDEN, Frederick Yates. XXII, 13
BORISLOW, Bernard. XXII, 150
BOWDEN, David Merle. XXII, 1
BOWIN, Carl Otto. XXII, 228
BOXER, Robert Jacob. XXII, 66
BOYD, Edwin Taylor. XXII, 67
BRAY, Richard Connell. XXII, 48
BREUER, Delmar Wallace. XXII, 187
BRICKER, Alice June. XXII, 242
BROCK, George William. XXII, 216
BROOKS, Thomas Marion. XXII, 109
BROOKSHIRE, William Alfred. XXII, 192
BROWN, Billie Wesley. XXII, 178
BROWN, Mortimer. XXII, 319
BROWN, William Paul. XXII, 33
BRYANT, Cyrus Anthony, Jr. XXII, 297
BUCH, Tomas. XXII, 88
BUCHANAN, Helen Eidson. XXII, 243
BUSHONG, Allen David. XXII, 223
BYRNES, William Richard. XXII, 13
CANFIELD, John Clair, Jr. XXII, 280
CARLILE, Clayton George. XXII, 67
CASSIDY, William Arthur. XXII, 277
CAWELTI, John George. XXII, 254
CERBUS, George. XXII, 319
CESCON, Lawrence Anthony. XXII, 68
CHAN, Wah-Yip. XXII, 283
CHANG, Yi-Han. XXII, 68
CHANTOONI, Miran Kevork, Jr. XXII, 44
CHAPNERKAR, Vasant Dinkarrao. XXII, 192
CHARDON, Roland Emanuel Paul. XXII, 223
CHASMAN, Chellis. XXII, 291
CHOROVER, Stephan Lewis. XXII, 283; 330
CHRISTIANSEN, Meryl Naeve. XXII, 14
CHRISTOPHER, Benjamin B. XXII, 106
CHRISTY, Marcia Elizabeth. XXII, 69
CHU, Kuang Yu. XXII, 232
CHU, Shirley Shan-Chi Yu. XXII, 88
CIOTOLA, Paul Vincent. XXII, 320
CLASTER, Daniel Stuart. XXII, 346
CLEMMER, Robert Rugh. XXII, 236
CLYDE, Robert Burdette. XXII, 151
COCKROFT, Lindon Uhle. XXII, 110
COHEN, Jerome. XXII, 350
COLBY, Holly Wester. XXII, 131
COLEMAN, Ralph Eugene. XXII, 132
COLLINS, William Beck. XXII, 14
COLOM, Juan. XXII, 1
COLWELL, Rita Barbara Rossi. XXII, 26
CONSALVI, Conrad. XXII, 330
COOK, Benjamin Jacob. XXII, 132
COOPER, Dale Edward. XXII, 268
COWAN, Wavell Frederick. XXII, 193
COX, Roger Lindsay. XXII, 255
CRAMER, Charles Leonard, Jr. XXII, 110
CREELMAN, Carleton Douglas. XXII, 331
CRISS, Cecil M. XXII, 89
CRITCHFIELD, John Geary. XXII, 134
CROSS, Robert Franklin. XXII, 233
CROSSMAN, George R. XXII, 308
CRUM, Mabel Irene Tyree. XXII, 245
CUSACK, Mary Ann. XXII, 357
DACEY, Michael Francis. XXII, 224
DAISHER, Nollie Belle Messer. XXII, 134
DAS, Chittaranjan. XXII, 20
DAVIS, Betty. XXII, 178
DAVIS, Joe. XXII, 255
DAVIS, John Rowland. XXII, 188
DAVIS, Marion Lorene. XXII, 358
DAVIS, Robert Southmayd. XXII, 256
DECK, Ronald Joseph. XXII, 297
DECKER, Robert Jay. XXII, 320
DeLONG, Howard. XXII, 285
DEL-PAN, José Felipe. XXII, 257
DESAI, Dhirajlal Keshavlal. XXII, 111
DICKSON, Stanley. XXII, 151
DI PIETRO, David Louis. XXII, 48
DOMAN, Robert Charles. XXII, 278
DOSTAL, Naida Marich. XXII, 179
DOYLE, Marvyl. XXII, 180
DRANOFF, Joshua Simon. XXII, 193
DREW, William Arthur. XXII, 366
DREW, William Howard. XXII, 112
DUBBS, Del Rose Marie. XXII, 27
DUPLER, Dorothy. XXII, 359
DUSINBERRE, William Warner. XXII, 237
DYMICKY, Michael. XXII, 69
EBBIN, Steven. XXII, 309
EBNER, Eugene. XXII, 322
EDMAN, John Henry. XXII, 258
EDWARDS, Herbert Weaver. XXII, 258
EGAN, Walter G. XXII, 298
EISEN, James David. XXII, 302
EISENBACH, Joseph Junior. XXII, 122
EISENBERG, Adi. XXII, 89
EISENBERG, Marvin F. XXII, 208
EL-BAYOUMI, Mohamed Ashraf. XXII, 90
EL-HAWARY, Mohamed Nasr Habib. XXII, 116
ELLIS, Daniel Russell. XXII, 135
ELNASR, Abd ELmonim Abu see Abu Elnasr, Abd ELmonim
EMERSON, Kenneth. XXII, 91
EVANS, Charles Marcus. XXII, 209
EVANS, William Rue. XXII, 49
FACK, Hans Juergen. XXII, 2
FAHIM, Mostafa Safwat. XXII, 8
FALK, Robert Allen. XXII, 70
FAULK, Charles Joseph. XXII, 122
FEHNER, Richard Edwin. XXII, 246
FEINGOLD, Eugene Neil. XXII, 310
FEY, Curt F. XXII, 331
FINN, William Daniel. XXII, 205
FIRTH, William Charles, Jr. XXII, 70
FISHER, Kenneth Deane. XXII, 21
FORSTER, Edith C. XXII, 181
FOSSAN, David Bruce. XXII, 291
FOSTER, Thomas Gray. XXII, 123
FRANCIS, Nelle Trew. XXII, 259
FRANTZ, John B. XXII, 238
FRASER, Donald Boyd. XXII, 91
FREEDMAN, David A. XXII, 268
FREEMAN, Benjamin. XXII, 50
FREEMAN, Eli Saul. XXII, 92
FREER, James Joseph. XXII, 347
FRESCOLN, Wilson Lysle. XXII, 259
FRIARS, Gerald Winston. XXII, 8
FRIEDMAN, Selwyn Marvin. XXII, 28
FRY, Kenneth A. XXII, 28
FULLER, Jerry Don. XXII, 26
FUNDERBURG, John Broadus, Jr. XXII, 366
FUNDERBURK, Henry Hanly, Jr. XXII, 40
FUNK, James Ellis. XXII, 194
FURMAN, Walter Laurie. XXII, 269
GAMBERONI, Narciso Louis. XXII, 136
GARDINER, Earl Edwin. XXII, 8
GARDNER, Robin Pierce. XXII, 194
GARREN, Ralph, Jr. XXII, 15
GEISLER, Charles Hoover. XXII, 92
GERDES, Egon Walter. XXII, 338
GERTMENIAN, Paul Harold. XXII, 339
GETTNER, Marvin William. XXII, 291
GIAMALVA, Mike John. XXII, 21
GILLESPIE, David E. XXII, 169
GINTER, Marshall Lloyd. XXII, 93
GLASCOCK, Homer Hopson, Jr. XXII, 298
GLATTHORN, Allan Adale. XXII, 181
GLAZER, Alexander Namiot. XXII, 50
GODBEY, James Luster. XXII, 136
GOLDSTEIN, Donald Aaron. XXII, 331
GOLDSTUCKER, Jac Landman. XXII, 116
GOLUBOW, Julius. XXII, 51
GORE, George Joseph. XXII, 117
GOSSETT, Dorsey McPeake. XXII, 15
GRANBORG, Bertil Svante Mikael. XXII, 209
GRANSKOU, David Matthew. XXII, 339
GRANT, Arthur Ira. XXII, 107
GRANT, Louis Russell, Jr. XXII, 59
GREENLEY, Robert Ziolkowski. XXII, 71
GREGORY, John Robert. XXII, 317
GRIFFITH, William Kirk. XXII, 3
GUISELEY, Kenneth Balm. XXII, 71
GUPTA, Shiv Kumar. XXII, 269
GUPTA, Umesh Chandra. XXII, 3
GUSTIN, Molly Malcolmson. XXII, 281
HAAS, Kurt. XXII, 332
HAGEMEYER, Richard H. XXII, 124
HAND, Samuel Burton. XXII, 234
HANLON, James Mortimer. XXII, 137
HANNA, Owen Titus. XXII, 195
HANNA, Samuel Charles. XXII, 269
HANNAN, Dennis Griffith. XXII, 260
HARBAUM, Kenneth Lee. XXII, 196
HARDISON, Richard Cheves. XXII, 152
HARING, Lee. XXII, 260
HARRAH, Larry Allen. XXII, 93
HARRIS, Wesley Lamar. XXII, 188
HARVEY, Lester James. XXII, 153
HASAN, Khurshid. XXII, 313
HASKELL, Judith Ann Parsons. XXII, 367
HASLUND, Ralph Leslie. XXII, 288
HAVENER, Philip Henry. XXII, 322
HAWARY, Mohamed Nasr Habib el- see El-Hawary, Mohamed Nasr Habib.
HEBB, Edwin Atkins. XXII, 10
HEBELER, Jean Ruth. XXII, 154
HEGGOY, Willy Normann. XXII, 238; 340
HERING, Robert Gustave. XXII, 213

HIGGINS, David James Monroe. XXII, 246
HILL, Kenneth Lee. XXII, 303
HILL, Peter B. XXII, 29
HILL, W. Merle. XXII, 154
HOFFMAN, Carl Stuart. XXII, 332
HOFFMAN, John Nathan. XXII, 107
HOFMANN, Peter L. XXII, 218
HONG, Sung Ho. XXII, 196
HOPKINS, Jon James. XXII, 359
HOPKINS, Kenneth Dean. XXII, 155
HORWITZ, Gerald. XXII, 299
HOWARD, John Hall. XXII, 229
HOWARD, Joseph Turner. XXII, 351
HOYME, Richard Gjermund. XXII, 182
HUBER, Robert John. XXII, 299
HUBERT, Richard. XXII, 138
HUBERT, Willis Jones. XXII, 156
HUNDLEBY, John Dennis. XXII, 333
HUNT, James G. XXII, 157
HUSAIN, Taqdir. XXII, 269
HUSHFAR, Farid. XXII, 288
HUTTA, Joseph John. XXII, 278
HYMAN, Aaron. XXII, 333
IANNIELLO, Louis C. XXII, 217
IBANEZ, Manuel Luis. XXII, 29
INGRAM, Gerald Eugene. XXII, 205
IRWIN, Edward Eugene. XXII, 247
IVEY, Marvin Lee. XXII, 183
JACKSON, Allen Keith. XXII, 340
JAHNSEN, Vilhelm James. XXII, 51
JAKOB, Fredi. XXII, 45
JAMES, Sydney Carter. XXII, 112
JAYEWARDENE, C. H. S. XXII, 351
JECKOVICH, Stephen. XXII, 118
JEFFREY, David Austin. XXII, 72
JERDEE, Thomas Harlan. XXII, 334
JOHNSON, Fred Lowery, Jr. XXII, 46
JOHNSON, Malcolm Julius. XXII, 4
JOHNSON, Ralph Glasgow. XXII, 247
JONES, Alfred. XXII, 34
JONES, Clyde Adam. XXII, 158
JONES, Dallas Eugene. XXII, 52
JONES, Jack Earl. XXII, 34
JOYCE, Bruce R. XXII, 170
KANZLER, William Harrison. XXII, 139
KAPLAN, Stanley. XXII, 214
KAPOSTINS, Eli Eglons. XXII, 334
KARIPIDES, Dimitrios George. XXII, 59
KATZ, Florine Klingenstein. XXII, 159
KEENEY, William Echard. XXII, 341
KEMPERS, John. XXII, 261
KENDALL, Harry White. XXII, 289
KENELLY, John Willis, Jr. XXII, 270
KENNEY, Helen Jeanette. XXII, 159
KENT, Donald Wetherald, Jr. XXII, 292
KENYON, Richard Reid. XXII, 209
KERN, Neil Vance. XXII, 73
KETCH, Clarence Willard. XXII, 352
KIDDER, George W., III. XXII, 40
KIDO, Hidehiko. XXII, 94
KIMBALL, John Robert. XXII, 139
KIRKSEY, Avanelle. XXII, 243
KISHABA, Albert Nobuhiro. XXII, 367
KLASSEN, William. XXII, 342
KLEIN, Dolph. XXII, 30
KLIONS, Herbert Lionel. XXII, 335
KNUTSON, Kent S. XXII, 342
KOLASA, Jan. XXII, 314
KONDNER, Robert Louis. XXII, 206
KOPP, Richard E. XXII, 210
KOPPENHAVER, Neil David. XXII, 323
KRALOVEC, Dalibor William. XXII, 140
KRATHWOHL, Carlton Lester. XXII, 125
KRUSÉ, Cornelius Wolfram. XXII, 233
LAMM, Jesse Mayo. XXII, 126
LAMPREY, Philip Shepard. XXII, 95
LANDE, Saul. XXII, 52
LANE, John Perry. XXII, 221
LANGFORD, Fred Frazer. XXII, 229
LAPITSKY, Mary. XXII, 244
LAWLER, John Joseph. XXII, 262
LAWSON, James Dean. XXII, 171
LAYDEN, George Kavanaugh, Jr. XXII, 197
LEATHERWOOD, James Murray. XXII, 53
LEE, Benjamin Whisoh. XXII, 292
LEE, George Chao-Chi. XXII, 206
LENAS, Leandros Philip. XXII, 197
LEONARD, James Howard. XXII, 197
LEVINS, Philip Leo. XXII, 95
LEVITT, Leonard Sidney. XXII, 73
LEWALD, Herald Ernest. XXII, 262
LEWIS, Lowell Nelson. XXII, 16
LIEBER, Albert John. XXII, 292
LINDSAY, Delbert William. XXII, 41
LINDSEY, Marvin Frederick. XXII, 35
LINFORD, Robert Guild. XXII, 198
LLORENS, Richard Edward. XXII, 216
LONSDALE, Richard Ellis. XXII, 225
LOPATO, Esther Wolf. XXII, 160
LORENZ, Max R. XXII, 96
LOTT, John Bertrand. XXII, 248
LOVE, Peter. XXII, 96
LU, Le-Wu. XXII, 206
LUDLUM, Kenneth Hills. XXII, 97
McBEATH, Ronald James. XXII, 161
McCLINTOCK, Roy Milo, Jr. XXII, 310
McDANIELS, David Keith. XXII, 293
McDONALD, James Clifton, Jr. XXII, 42
McDUFFIE, Roger A., Jr. XXII, 281
McGILLIARD, A. Dare. XXII, 304
McGRATH, James Joseph. XXII, 336
McKINNEY, Earl Harry. XXII, 270
McKINNON, Ronald Ian. XXII, 120
McMILLEN, Daniel Morris. XXII, 162
McNEILL, William. XXII, 60
McNELLY, John Taylor. XXII, 347
MAGINNIS, Richard Lawrence. XXII, 31
MAHONEY, William Clement. XXII, 230
MARCINKOWSKY, Arthur E. XXII, 97
MARIA, Hanna Judeh. XXII, 99
MARKER, Robert Winslow. XXII, 141
MARTIN, James Grubbs. XXII, 74
MASHBURN, Thompson Arthur, Jr. XXII, 75
MAY, Frank Pierce, III. XXII, 198
MAYFIELD, Robert Charles. XXII, 225
MAYS, David Arthur. XXII, 17
MELNICK, William. XXII, 360
MERCHANT, Gloria Bader. XXII, 281
METZGAR, Don Phillip, Jr. XXII, 36
MEYER, Victor Eugene. XXII, 99
MILLER, W. Lamar. XXII, 76
MILNER, Cooper. XXII, 239
MIRAGLIA, Gennaro John. XXII, 31
MISSMAN, Rolland Albert, Jr. XXII, 299
MITCHELL, James David. XXII, 9
MITCHELL, William Hugh. XXII, 17
MITRA, Chittaranjan. XXII, 100
MOMSEN, Richard Paul, Jr. XXII, 226
MONTAGUE, Anita C. XXII, 324
MORGAN, Esther Marguerite. XXII, 163
MORGAN, Owen W. XXII, 163
MUELLER, Frederick. XXII, 282
MULLINS, Roland Thomas. XXII, 120
MUMFORD, Russell Eugene. XXII, 11
MURRISH, Charles Harold. XXII, 210
MUTCHMOR, John Alexander. XXII, 304
MYERS, Earle Frederick. XXII, 271
NABAVI, Aziz. XXII, 315
NAPIER, Edward Anthony, Jr. XXII, 54
NASH, Richard Lawrence. XXII, 164
NASS, Margit M. Kahlbrock. XXII, 368
NELSON, Eric Thompson. XXII, 199
NIHAN, James Fredrick. XXII, 126
NOBLE, Larry Mark. XXII, 293
NORTON, Joseph Daniel. XXII, 36
NOVAK, Joseph Donald. XXII, 271
NUENKE, Richard Harold. XXII, 54
OBEAR, Frederick Woods. XXII, 61
OBRECHT, Dean Hubert. XXII, 252
ODA, Fujio. XXII, 288
OFCHUS, Leon T. XXII, 165
OGBORN, Lawrence Lyle. XXII, 211
OH, Joon Suk. XXII, 61
OLIVA, Lawrence Jay. XXII, 240
OLIVE, Aulsey Thomas. XXII, 368
ORLIN, Louis Lawrence. XXII, 235
ORR, Mary Faith. XXII, 24
OTTINGER, Donald Ray. XXII, 324
PACKARD, John Cooper, Jr. XXII, 141
PAINTER, William Ernest. XXII, 240
PALMOUR, Hayne, III. XXII, 199
PARKER, Dorothy Elizabeth Hagman. XXII, 263
PARKER, Jerald Dwain. XXII, 214
PATTERSON, Kenneth Denton. XXII, 108
PAUL, Biraja Bilash. XXII, 200
PERRY, Doris Cahoon. XXII, 317
PETERS, Robert Anthony. XXII, 253
PHILLIPS, James Archibald, Jr. XXII, 172
PLUMMER, Thomas Henry, Jr. XXII, 18
PORGES, Sarah Berman. XXII, 236
POSKA, Forrest Lynn. XXII, 200
POST, Theodore Beemer. XXII, 305
POWERS, Harold Oren. XXII, 42
PRATT, Joseph Neal. XXII, 18
PRENSKY, Wolf. XXII, 37
PRIDDY, Earl Washington. XXII, 361
PROCTOR, Robert Allen, Jr. XXII, 343
PROMISEL, David Mark. XXII, 336
PSARROS, Evangelos Eleftheriou. XXII, 22
PUGLIESE, Donato Joseph. XXII, 316
PURCELL, William Paul. XXII, 100
PURI, Narindra Nath. XXII, 211
PUTMAN, George Wendell. XXII, 230
PYKE, Thomas Richard. XXII, 38
QUISENBERRY, Richard Keith. XXII, 76
RAJAGOPAL, Venkatesan. XXII, 212
RAZAVY, Mohsen Modarres. XXII, 294
REHDER, Robert Richard. XXII, 118
REIFF, Robert Frank. XXII, 219
REISER, Martin. XXII, 325
REKASIUS, Zenonas V. XXII, 212
RESCONICH, Samuel. XXII, 77
RHOADES, James Lawrence. XXII, 55
RICH, Annette Louise. XXII, 127
RICH, Austin Julius. XXII, 77
RICHARDSON, Evan Carleton. XXII, 172
RICHARDSON, Wyman. XXII, 272
RIEMAN, George Frederick, Jr. XXII, 286
RIPLEY, Dana Phelps. XXII, 264
RIZEK, Robert Leroy. XXII, 113
ROARTY, Joseph Daniel. XXII, 215
ROBBINS, Lillian Cukier. XXII, 348
ROBERTSON, Joseph Gray, Jr. XXII, 337
ROGERS, Marion Elizabeth. XXII, 145
ROHMAN, David Gordon. XXII, 249
ROSE, Kenneth. XXII, 213
ROSENBACH, John H. XXII, 165
ROSENBERG, Anna Maria Larson. XXII, 326
ROSENFELD, Daniel David. XXII, 78
ROSENFELD, Joseph G. XXII, 326
ROSS, Donald Kenneth. XXII, 186
ROSS, Lawrence James. XXII, 78
ROY, James Peter. XXII, 184
RUEHLE, John Leonard. XXII, 22
RUETHER, Millard Herbert. XXII, 284
RULE, Henry Burt. XXII, 249
RUSSELL, Harold David. XXII, 46
RUSSELL, Thomas J., Jr. XXII, 55
SABA, William George. XXII, 101
SABATH, Mildred Rochelle. XXII, 174
SABER, Nicholas John. XXII, 272
SANDERSON, Richard Arlo. XXII, 235
SATO, Toshio. XXII, 344
SAUNDERS, Robert James. XXII, 143
SCHABINGER, John Robert. XXII, 10
SCHALEGER, Larry Leroy. XXII, 78
SCHENLER, William Walter. XXII, 207
SCHIESSER, William Edward. XXII, 201
SCHILLING, Lester Lorenzo, Jr. XXII, 361
SCHLATTER, Fredric William, S. J. XXII, 252
SCHMIDT, Victor Hugo. XXII, 300
SCHRADER, Sister M. Walter Reginald, O. P. XXII, 272
SCHUSTER, Robert Lee. XXII, 207
SCHWAAR, Robert Henry. XXII, 201
SCHWICH, Luther Clarence. XXII, 145
SCOTT, Thomas John. XXII, 337
SEDLAK, John Andrew. XXII, 79
SEMAAN, Khalil Ibrahim Hanna. XXII, 253
SEVON, William David, III. XXII, 231
SHAND, John Douglas. XXII, 371
SHAW, Leonard Glazer. XXII, 213
SHERMAN, Gordon Rae. XXII, 273
SHETH, Kirti Shantilal. XXII, 84
SHIH, Cornelius Chung-sheng. XXII, 189
SHOTICK, Andrew Luther. XXII, 166
SHOWERS, Lloyd Wharton. XXII, 142
SILAGYI, Dezo Vincent. XXII, 128

SILVERMAN, Bernard. XXII, 80
SILVERSTEIN, Edward Allen. XXII, 294
SINGER, Jerome Everett. XXII, 318
SINGH, Harbans. XXII, 146
SINGH, Madan Mohan. XXII, 217
SINGH, Mahendra. XXII, 38
SINHA, Mahendra Kumar. XXII, 300
SKALA, James Herbert. XXII, 221
SKINNER, David Lloyd. XXII, 80
SMITH, Eugene Vernest. XXII, 354
SMITH, Georgia Caldwell. XXII, 273
SMITH, Russell George. XXII, 81
SMITH, Shirley Allen. XXII, 327
SMITH, Stuart Elwood. XXII, 166
SOBEL, Jordan Howard. XXII, 286
SOFFEN, Gerald A. XXII, 39
SOKOL, Robert. XXII, 352
SOMMERS, Ronald Kenneth. XXII, 362
SOR, Kamil Mehmet. XXII, 4
SPENCER, John Valentine. XXII, 222
SPERRY, Florence Boyd. XXII, 129
SPILNERS, Ilgvars Janis. XXII, 81
SPRING, Samuel. XXII, 82
SQUIRES, Burton Elliott, Jr. XXII, 294
STABLER, Robert Coleman. XXII, 295
STACKMAN, Robert William. XXII, 82
STEEFEL, Lawrence D., Jr. XXII, 220
STEPHENS, Edna Buell. XXII, 264
STOUT, Roy Glendon. XXII, 114
STRAUB, Darel Kerr. XXII, 61
STREU, Herbert Thomas. XXII, 369
STRICKLAND, Erasmus Hardin, Jr. XXII, 56
STRUCK, Robert Frederick. XXII, 82
STURROCK, Thomas Tracy. XXII, 19
SUTTER, Cyril Robert, C. PP. S. XXII, 328
TAPPMEYER, Wilbur Paul. XXII, 62
TEN BRINK, Eugene Lester. XXII, 241; 344
TERADA, Kazuji. XXII, 101
TESTA, Anthony C. XXII, 102
THOMAS, Alvin David, Jr. XXII, 217
THOMAS, Methratta Paul. XXII, 202
THOMPSON, Paul Joel. XXII, 31
THOMPSON, Richard Rogers. XXII, 231
THOMSON, Allan. XXII, 265
THORBJORNSEN, Eyvind. XXII, 11
TIEN, Chang-Lin. XXII, 215
TIETZ, William John, Jr. XXII, 305
TILLEY, John Leonard, Jr. XXII, 274
TOMBES, Averett Snead. XXII, 56
TRANK, John Walter. XXII, 306
TRUHER, Helen Burke. XXII, 184
TSUNG, Cheng Chih. XXII, 187
TURSE, Richard Sanford. XXII, 46
TYSON, Raymond Warren. XXII, 363
ULRICH, Valentin. XXII, 39
UNKOVIC, Charles M. XXII, 353
UNRAU, Abraham Martin. XXII, 57
USATEGUI, Magdalena. XXII, 63
VALIAN, Maxine Kent. XXII, 250
VAN ARSDEL, Rosemary Thorstenson. XXII, 25
VANDEMARK, Joseph S XXII, 19
VANDERKOOI, Nicholas, Jr. XXII, 102
VAN DEVANDER, Donald Mouzon. XXII, 130
VAN DE WETERING, Richard Lee. XXII, 275
VANZANDT, Bill Ray. XXII, 175
VAUGHAN, Worth Edward. XXII, 102
VENTURELLA, Vincent Steven. XXII, 85
VON FRANKENBERG, Carl Alexander. XXII, 10
WADE, Eugene Wellington. XXII, 167
WAGGONER, James Arthur. XXII, 295
WALDMAN, Marvin. XXII, 328
WALKER, John Martin. XXII, 5
WALKER, John Neal. XXII, 189
WALLACE, Emmett. XXII, 119
WALTON, Harold Vincent. XXII, 190
WARREN, Martin. XXII, 202
WARSHAW, Israel. XXII, 279
WASINGER, Gordon Bernard. XXII, 143
WATERS, Louis Addison, Jr. XXII, 265
WATT, Richard Franklin. XXII, 12
WATTS, Steighton Arthur, Jr. XXII, 311
WATZMAN, Nathan. XXII, 284
WEBSTER, John Thomas. XXII, 275
WEI, Robert Peh-ying. XXII, 215
WEINBERG, Elliot Carl. XXII, 276
WEINLE, Paul Louis. XXII, 83
WEINSTEIN, Allan. XXII, 203
WELCH, Charles Darrel. XXII, 5
WELLER, Neil Jack. XXII, 354
WERMUND, Edmund Gerald, Jr. XXII, 232
WESSON, Robert G. XXII, 311
WHITWORTH, Charles Walters. XXII, 344
WIEDER, Grace Marilyn. XXII, 104
WIEGAND, William George. XXII, 266
WIGHTMAN, James Pinckney. XXII, 83
WILKINSON, Stanley Ralph. XXII, 6
WILLAR, Sidney Blair. XXII, 185
WILLIAMS, Dorothy Slade. XXII, 356
WILLIAMS, Floyd Wendell. XXII, 114
WILLIAMS, Jack Eugene. XXII, 144
WILLIAMS, Thomas B. XXII, 168
WILLIS, Merton Joseph. XXII, 219
WINGFIELD, Clyde Joye. XXII, 316
WINKLER, Donald Allen. XXII, 203
WISHART, David Matthew G. XXII, 276
WITCHER, Wesley. XXII, 23
WODIN, Martin Henry. XXII, 329; 338
WOODMANSEE, Wayne Earl. XXII, 105
WU, Chisung. XXII, 84
YOUNG, William M. XXII, 176
YOURGLICH, Anita. XXII, 355
ZEBOUNI, Nadim Hanna. XXII, 301
ZENZ, Frederick A. XXII, 204
ZERBY, Clayton D. XXII, 295
ZIEGER, Herman Ernst. XXII, 84
ZUCKER, Martin Samuel. XXII, 296
ZUCKER, Norman L. XXII, 312